Good Results in Service Tests of Concrete-Base Track on Northern Pacific

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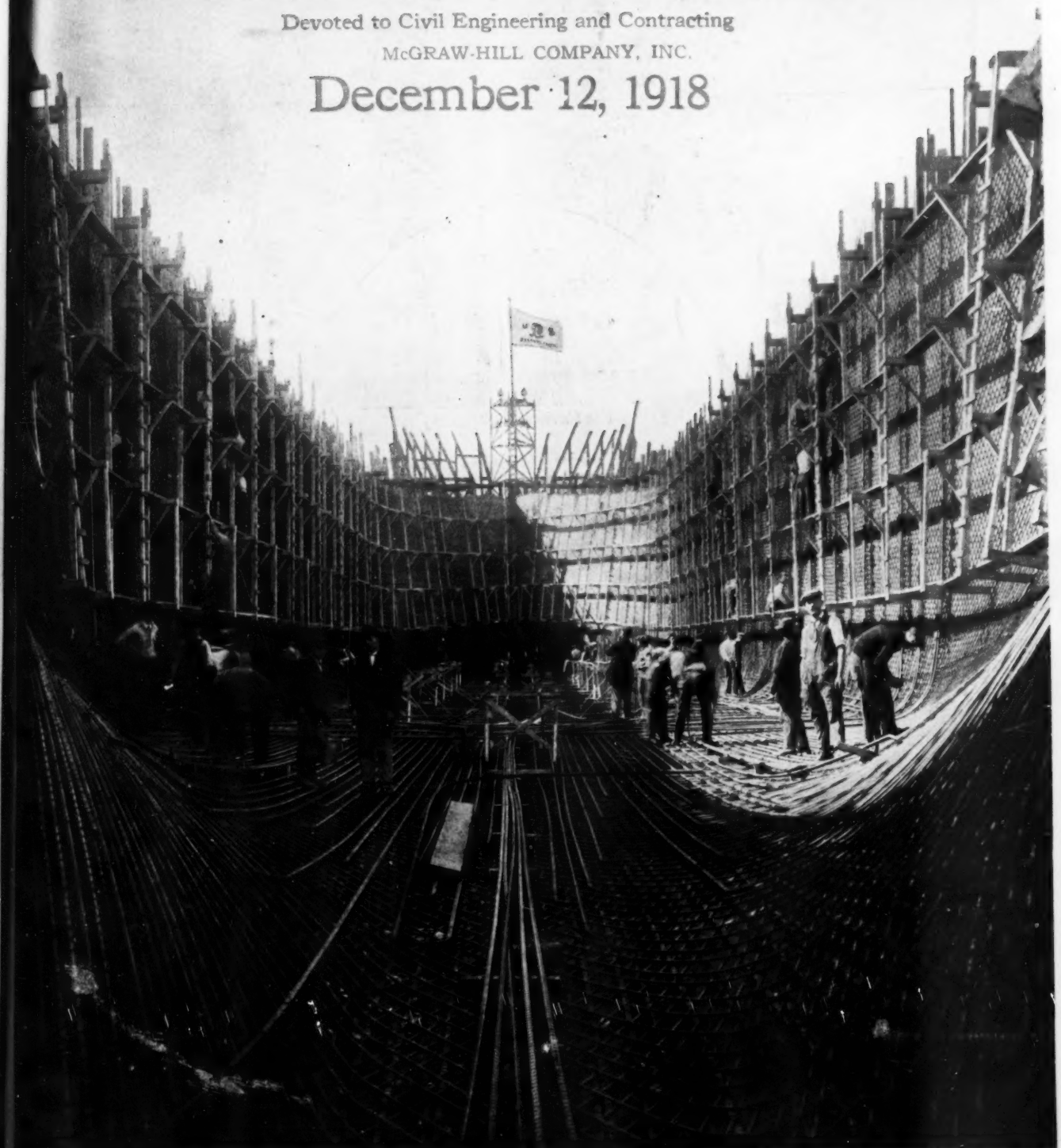
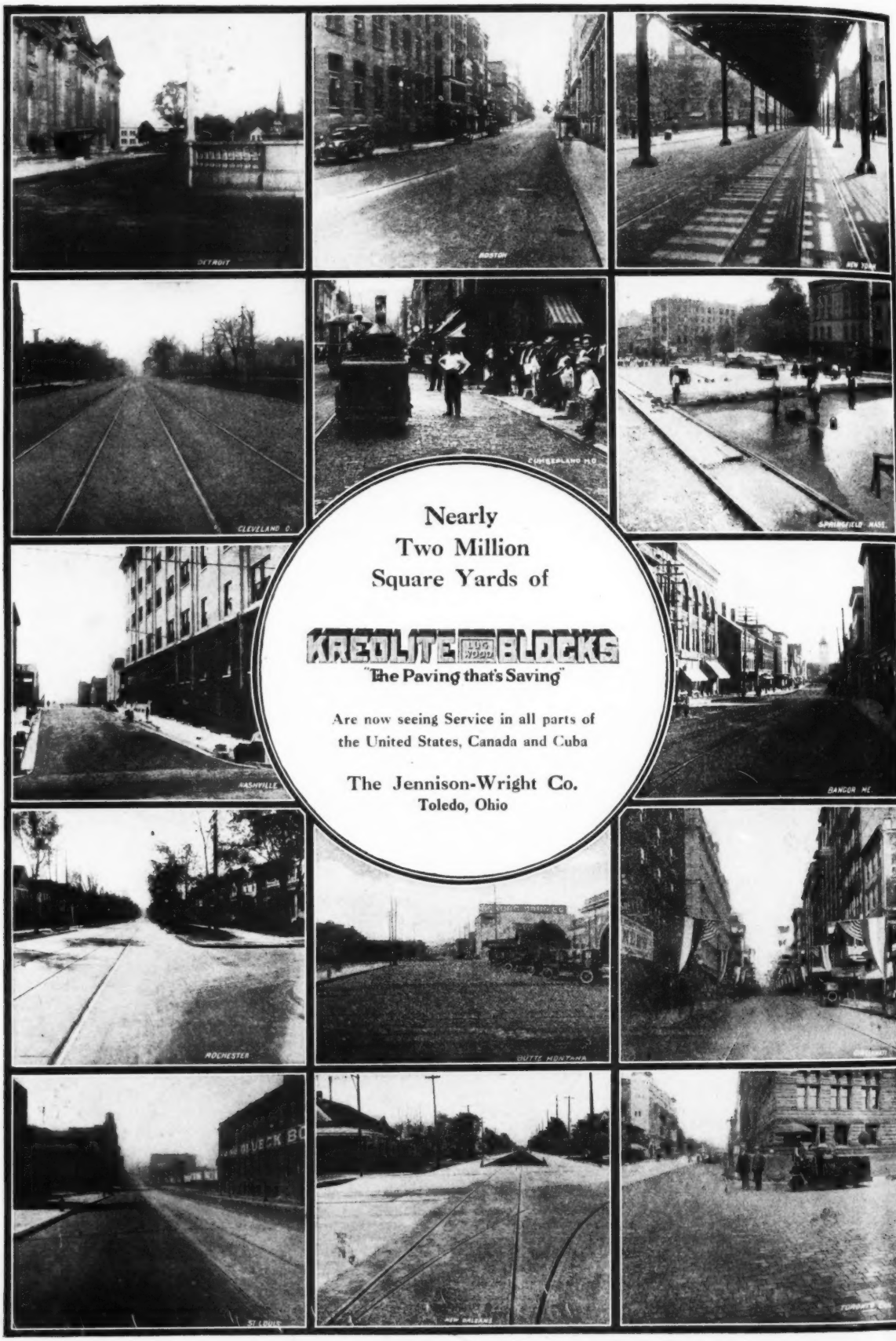
December 12, 1918



cing Steel In New 3500-Ton Government Concrete Ocean-Going Ship at Fougner Yard on Long Island



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Engineering News-Record

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E. J. MEHREN, *Editor*

CHARLES WHITING BAKER, *Consulting Editor*

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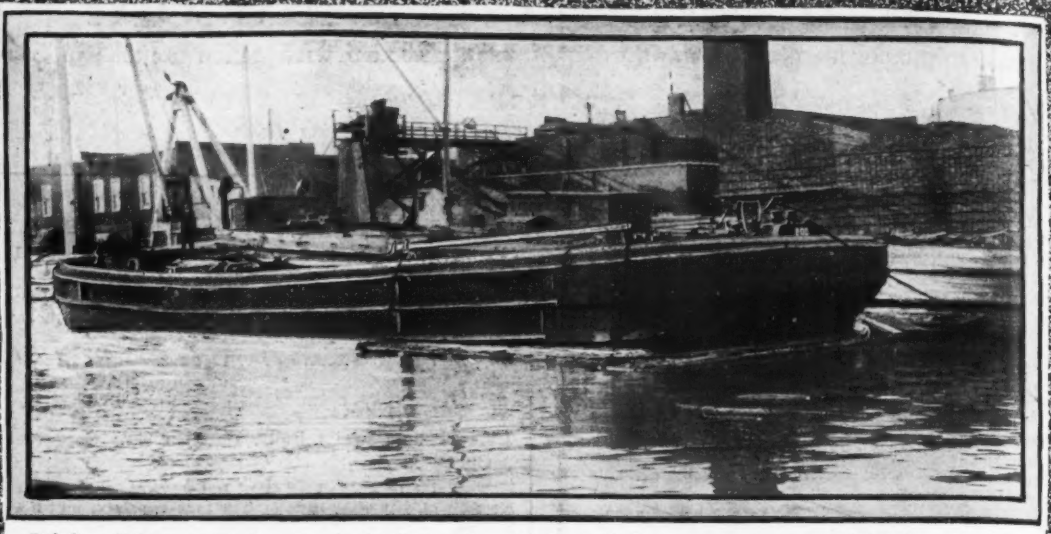

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DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, *Editor* — Charles Whiting Baker, *Consulting Editor*

Volume 81 — NEW YORK, THURSDAY, DECEMBER 12, 1918 — Number 24

Buffalo Makes Good Start in Reducing Its Water Waste

BUFFALO has so long been a horrible example of water waste that it is a pleasure to be able at last to point to it as an illustration of how waste may be cut down and coal and labor saved by a few months of intelligent, systematic effort. What has been accomplished by a water-waste survey of only a part of the city was told by the water commissioner of Buffalo on p. 1033 of last week's issue. When the whole city has been covered greatly increased savings may be expected, but there will yet remain as a possibility and a duty the installation of water meters, in order to hold down and reduce waste further, and also as the only just method of distributing the cost of water service among consumers.

Shall We Lose Much of War Benefit?

WE CONFESS utter inability to understand the President's statement, in his message to Congress last week, that there was no need to appoint a special reconstruction agency, on the theory that the return to a peace basis will outstrip any study that can be made. Existing agencies, it is true, may be able to assist in solving some of the problems, but existing agencies do not promise well in such a task as the disposition of our railroads. Even the President indicates rather plainly his lack of faith in Congressional handling. We had thought that reconstruction included more than the discontinuance of war contracts. We took it to embrace the railroad problem, the revamping of the Sherman act, and all manner of legal and legislative formulation which will preserve the good things developed by the war. The President apparently does not so hold—much to the detriment, it seems to us, of the country. We stand to lose by neglect much that we might gain if adequate studies were made.

Centralization of Materials Standardization

TWO papers on standardization of materials in England, presented last week before the American Society of Mechanical Enginers, touch intimately the proposals current for the creation of a new body to deal with standardization in the United States. So far these proposals have appeared to lack a specific objective. The papers mentioned suggest that with regard to purposes and governing conditions the two countries exhibit radical differences. If such differences exist, it will be obvious that most careful study of the subject is necessary before centralized American standardization can be discussed with profit in concrete terms. That the British standardization work depended on Government participation is also of peculiar significance at the present time, when questions of centralized action by or with aid of the Government are, and for some time will continue to be, in a state of suspense. After thoughts in this field have crystallized, careful and broad-gage discussion will furnish a working basis for determining the proper scope of standardization work in this country, and the need for displacing or centralizing existing agencies. These are questions for primary disposition. The subject of international coöperation—which, as an ideal, undoubtedly takes precedence—must as a practical matter become secondary. The existing requirements and facilities of American industry and technical organization promise to be the governing elements in the problems of the moment.

Concrete-Base Track Departs From Standard Type

A RADICAL development in railway track construction is embodied in the unballasted concrete-slab construction now in use on the Northern Pacific Ry., and described on another page of this issue. Its importance lies in the facts that this track has been built for main-line conditions in open country, and that it has given good results during four years of service. The general idea is not new, for track built upon a permanent concrete base has been the subject of several designs. Nor is the fact of actual construction new, since a concrete base is the fundamental feature of some types of track employed for tunnels and large passenger stations. But unballasted track with a concrete base on open main line is a marked departure from standard practice. Cost figures are not available, but the maintenance cost is reported as being far below that of track of the ordinary type on the same line. It is to be noted also that while maintenance is a source of continual work and expense on ordinary track, it is likely to be required only intermittently and at long intervals with this type of construction. Altogether, the Northern Pacific experiment seems to be a big step ahead.

Edgar Marburg Memorial Scholarship

NO MORE appropriate form of memorial to the memory of Edgar Marburg than the proposed permanent scholarship in his own institution, the University of Pennsylvania, to which he gave practically the whole of his working life, could be conceived. The plan an-

nounced in our news pages, by which the American Society for Testing Materials is collecting the funds for a memorial scholarship, is worthy of the highest commendation. This form of recognition would appeal to Dr. Marburg himself, because his whole heart went out in the true teaching instinct to develop young engineers into men worthy of the great profession to which he gave his life. It is to be hoped that the future students who will benefit by this scholarship may fully appreciate the honor and repay it a hundredfold by their later contributions to engineering progress. It is unfortunate that only members of the A. S. T. M. have been asked to subscribe. There is no doubt whatever that thousands of other engineers the country over would be glad to add their tribute to a man who had been their inspiration and guide either in the days of their early training or in their engineering experience.

Public Works the Only Available Safety Valve

THREE weeks ago we strongly advocated a policy of extensive public works construction, so that such works might "take up the slack" in the transfer of labor from war to peace occupations. Since that time a great movement has gotten under way for inaugurating public works on a large scale. One hears of it from every direction. The President advocated such a policy in his message, the Secretary of Agriculture declared for increased Federal highway appropriations, the business men of the country assembled at Atlantic City saw in it a safety valve in the possible labor crises, the War Labor Policies Board is polling the Governors and the mayors as to the construction programs of their respective states and cities, and chambers of commerce throughout the country are getting back of the movement. The policy is one that all may and should indorse. Those who scruple about recommending expenditures at higher costs than may prevail when really normal conditions are here must face the far more serious alternative of quelling the disturbances that are inevitable if there is widespread unemployment. The bill to the public from such a situation will be far heavier than the excess payment for public works inaugurated under present conditions. No less scrupulous a man than the President does not hesitate to recommend immediate beginning on a large construction program. The movement should have the support of every thinking man and of every engineering society and contractors' organization. These bodies can help much by bringing their influence to bear on their local chambers of commerce and their Congressional and state representatives.

A Wave of Liberalism Sweeping Over American Business

NO ONE came away from the mammoth reconstruction congress at Atlantic City last week without a lifting of the spirit. One had only to mingle with the groups, catch the chance phrase and grade the emphasis of applause, to feel the optimism, the idealism and the fine sense of service which pervaded the meeting. The American business man, as represented by the 5000 upstanding, prosperous representatives there, realizes in his heart that he faces a new day. He knows that his partnership with labor is no longer a mere catchword, and the solidarity of the world no longer a dream. Therefore he spontaneously rises in wild applause when the richest man in the world announces an industrial creed of startling radicalism; therefore he pays a unanimous tribute to an assertion that commerce is service and the goods of the United States must be shared freely with the world.

But when these same business men come to set down their conclusions in cold blood, they not only are hampered by the iron rigidity of words, but their ingrained conservatism is such that they hesitate to express openly that which their actions have shown they feel. Many of the 32 resolutions adopted in Atlantic City are perfunctory; more are elusive, and some have too much of that "let-us-alone" spirit which did more than anything else some years ago to discredit business. Taken all in all, they probably represent the dry bones of the proceedings, but somehow they fail to reproduce the flavor of the congress itself.

Reconstruction is only a word; what it tries to represent is the program for a new era. It was too much to expect that in a few day's conference—even so diversified and talented a one as that held last week—such a program could be evolved in finished form, but if those who were at Atlantic City succeed in bringing home to their friends and associates an adequate interpretation of the spirit in which American industry is going into the business of rebuilding the world, the words of the program as embodied in the 32 resolutions have no importance. Those who eventually must frame the reconstruction policies of this country cannot possibly miss realizing the wave of liberalism that has swept over American business.

Railway Street-Crossing Floors and Bridge Floors

PROGRESS in waterproof floor construction for railway street crossings, as reviewed in the article on p. 1081 of this issue, has come about through a process of successive approximation applied to a many-sided and changeable problem. The recorded experience is equivalent to a long series of experiments, made at the cost of many thousands of dollars; it should be valued accordingly. Still greater value can be given to it if the observations and experience of other engineers who have had the same problem to deal with are joined to it.

One prominent characteristic of the problem which bridge engineers have had to solve in the case of railway crossings over streets is the evolution of the problem itself during the course of its solution. This is so common in engineering as to be virtually characteristic, and it would be a mistake to look on the progressive perfection of design as being necessarily a trial-and-error process. The early solutions are in many instances quite perfect adaptations to the conditions imposed on the designer. Subsequently, experience with one form of construction leads to imposing further requirements, which are then met by a more highly developed construction. Thus the problem and its solution advance abreast of each other. Time is required for progress of this kind, and accordingly the record

of floor constructions given in this issue extends over a considerable span of years.

Recalling the early stages of development of street-crossing floors—for example, the period when open floors with drip pans suspended below them were used—it may be seen clearly that the demands made upon the designer became continually more severe and complex. What shaped the history of the subject was not so much the growth of the engineer's ability, but the growth of the world's needs and wants. These have now reached a high level, as indicated by the highly developed solutions. No such high level has been reached in the closely related field of bridge floors in general.

Up to now the question of bridge floors in general has never been approached from the point of view represented in Mr. Welty's article. Other demands were controlling, chief among them the demand for rigidity and power to absorb vibration, and the quite opposite demand for lightness. Various floor types of great merit have been brought out; yet in the main we are still on the basis of the primitive solution, the open-tie floor.

Looking forward, the possibility may be seen of great elaboration in bridge-floor construction. When such development comes, it may ultimately converge toward the line of advance in street-crossing floors. If that prove to be the case, we may ultimately have a single general-service type of floor, meeting the demand for waterproof character as well as that for rigidity and freedom from vibration, and possibly also the demand for lightness. But before such a result can come definitely into prospect, much further evolution of the bridge-floor problem itself must take place. Pending this, bridge-floor designs are bound to show forms of construction differing radically from those discussed in the present issue.

A Great Opportunity for Service to Engineers

AN OPPORTUNITY to do real good in connection with the readjustment of our national activities to non-war conditions is open to the employment bureau just established by the national engineering societies. An unusual proportion of engineers entered war work in one way or another. The time is at hand when this war work will be ended and a large number of these engineers must find employment. Their pre-war engagements were such that no place awaits their return from war service. Many of them are young men who cannot afford to remain long without work. The direction of these engineers to places where their training will be useful is an undertaking not only of national benefit, but the best possible way for the engineering societies to win the loyalty of the profession. Only a false viewpoint prevented this work from being undertaken with vigor years ago.

If anybody will examine critically into the reasons why engineers fail so lamentably to make an impression on public affairs, it will be found that one explanation lies in the pitiful lack of coöperation among them in anything beyond the reading of voluminous papers on subjects about which the public cares nothing. The very best coöperation, the fundamental coöperation, among men engaged in any line of work, professional or commercial, is that which helps them secure for themselves and their families more of the pleasures of life. These pleasures generally call for time, or money, or both. Coöperation which only results in the distribution of a little more special information is incomplete and deceptive, for it creates the impression that all that is needed for success is to know how. This is hopelessly fallacious; knowing how must be supplemented by ability to sell that knowledge to the man who needs it. Lack of salesmanship is what holds down the engineering profession, and not lack of knowledge.

This is shown by the condition facing thousands of engineers, and particularly civil engineers, who will soon be looking for engagements. They have no idea where these engagements can be found; they must hunt about until they happen upon something which they can do. Few of them have probably had to hunt long heretofore, or to state their qualifications in a business-like way. They may have recommendations from former employers, which mean little in most cases to prospective employers. So far as help in securing employment is concerned, they are left far behind the skilled workmen who will return from the Army and the Navy.

In undertaking the task of helping these men to obtain employment, the societies will render a service of which they may well be proud. It is assumed, of course, that the task will be properly done. This does not mean merely to receive the names of engineers looking for engagements and to send the names to applicants for engineering assistance. That is but the beginning of helpful employment service. What must be done is to go out into the world and "sell" engineers to those who need them. The country must be taught that the best place to come for engineers is the employment bureau of the national societies, and that can be taught by intelligent publicity only. It means a careful sifting of the record of each civil engineer who is looking for an engagement, in order that the essential facts about him shall be given fairly and clearly. It even means keeping a record of men who are not out of jobs but whose talents are not fully utilized in their present engagements. Needless to say, the bureau, too, should be a watchful counselor regarding what is adequate engineering compensation.

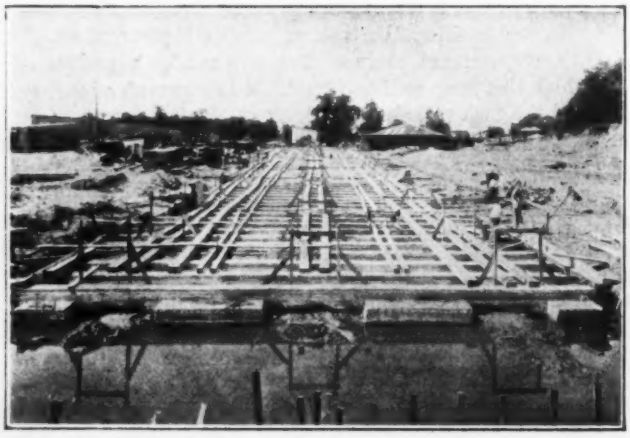
In short, the societies should help their members and engineers generally to obtain the work for which they are best suited. That is a really useful service which will go far to help the prosperity of the members of the profession, and it is only by visibly increasing their prosperity that the general public will in turn give them a higher rating. When the steam-shovel man gets higher pay than the assistant engineer who is in charge of the work, the public inevitably says that the shovelman is the more important fellow. The public does not know that the shovelman's wages have been raised by the shrewdest kind of coöperative work, that the engineer's salary is kept down on account of a false feeling that it is unprofessional to act together to obtain engagements and that the engineer is on too elevated a plane to care much about what he earns, except in the midst of his family circle.

The societies' employment bureau has a great opportunity. Every engineer will look to it for results and will coöperate to the utmost to make it a success.

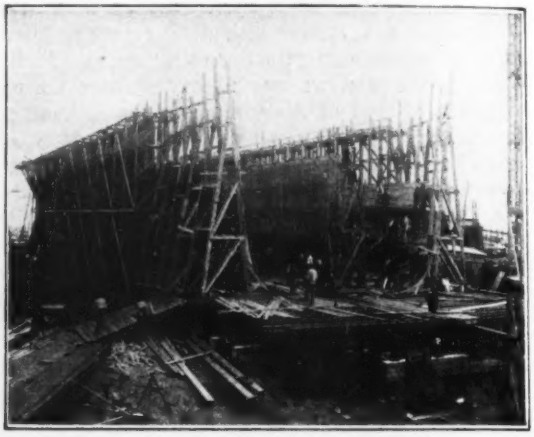
Building a Government 3500-Ton Concrete Ship

Fougner Yard Has Concrete Ways—Reinforcement Tacked to Outside Forms and Finish Put on With Cement Gun—Air Hammers on Forms Compact Concrete

ONE of the Emergency Fleet Corporation's new concrete ships is fast approaching completion in the yard of the Fougner Concrete Shipbuilding Co., on Flushing Bay, Long Island. The ship was started on Aug. 20; the first run of concrete on this 3500-ton vessel was poured on Nov. 6, and it is expected to launch early in January. The company is associated with a Norwegian firm of the same name which has for some years been building small concrete craft, but in the construction of this new ship, the second largest concrete vessel yet attempted, the contractors, in coöperation with the supervising Government engineers, had to elaborate old methods and devise new ones, so that much of the work was really of a pioneer nature. Important among the details of the construction were the use of framed trestles carrying the outside forms, the suspension of inner form frames, the tacking of the outer steel on the forms with subsequent covering by cement-gun concrete, and the use of air hammers on the forms to compact the concrete.



CONCRETE SHIP ON FLUSHING BAY WAS BUILT ON REINFORCED-CONCRETE SHIPWAYS



OUTSIDE TRESTLE FOR CONCRETE SHIP ALSO IS SUPPORT FOR OUTER FORMS

The ship has a dead-weight carrying capacity of 3500 tons, is 281 ft. 9 in. long, of 46-ft. beam, and 26½ ft. molded depth. It was designed by the Fougner company and revised and approved by the Concrete Ship Section of the Emergency Fleet Corporation. The design is, however, not to be confused with that of the standard 3500-ton concrete ship designed by the corporation, and described in *Engineering News-Record* of July 4, p. 17. The Fougner ship has heavy transverse frames spaced 4 ft. on centers, a center and two side keelsons, four bulkheads, one fore, one aft and two inclosing engine and boiler rooms. The deck is carried by two continuous girders forming the hatch coamings and is supported by widely spaced concrete-filled pillars made of heavy iron pipe with flanged heels and heads. The side keelsons are placed so that the steel pillars are carried at their intersection with the floor-beams. The launching ways are placed directly under these side keelsons, so that any unbalanced loading obtained in launching will be distributed readily to the adjacent floor-beams.

One of the distinctive features of this ship is the omission of deep tanks, the feed and ballast water being carried in the double bottom. The raised portion of the tank top is then used as the main boiler and engine floor. The bridge, forecastle and poop decks are all of concrete.

In general, the bottom and side shells are 5 in. thick. The side shell reinforcement consists of two layers of diagonally placed reinforcement of ½-in. and ⅝-in. square deformed bars. The deck varies somewhat, with an average thickness of 4½ in. At 6 ft. above the water line a horizontal bilge girder is carried all around the ship, running flush with the tank-top slab. This girder is used for stiffening the bilge and is also utilized in making the first stop in the concreting operation, which takes in the floor system up to the center of this girder. The side slabs are considerably thickened at the bilges and at the deck line, to permit the carrying of the heavy longitudinal steel reinforcement in these regions. The floor-beams and the frames in general are 8 in. thick, except in the tank-top section, where they are 5 to 6 in.

Trestle and Staging Details.—The yard of the company is situated at North Beach, Long Island, on the west shore of Flushing Bay. It was originally the site of a summer garden resort, with the usual accompaniment of dance halls, roller-skating rinks, etc. These buildings were admirably suited for the purpose of shipbuilding—the skating floor, for instance, of matched lumber, making an almost perfect mold loft, and the dance hall being readily adapted to the uses of a carpenter shop. At the side of the Government yard the company is building, in an entirely separate plant, several concrete barges and lighters.

The preliminary work of building the Government ships consisted of the construction of reinforced-concrete and pile ways, and the dredging of the outshore area to provide sufficient depth for launching. The

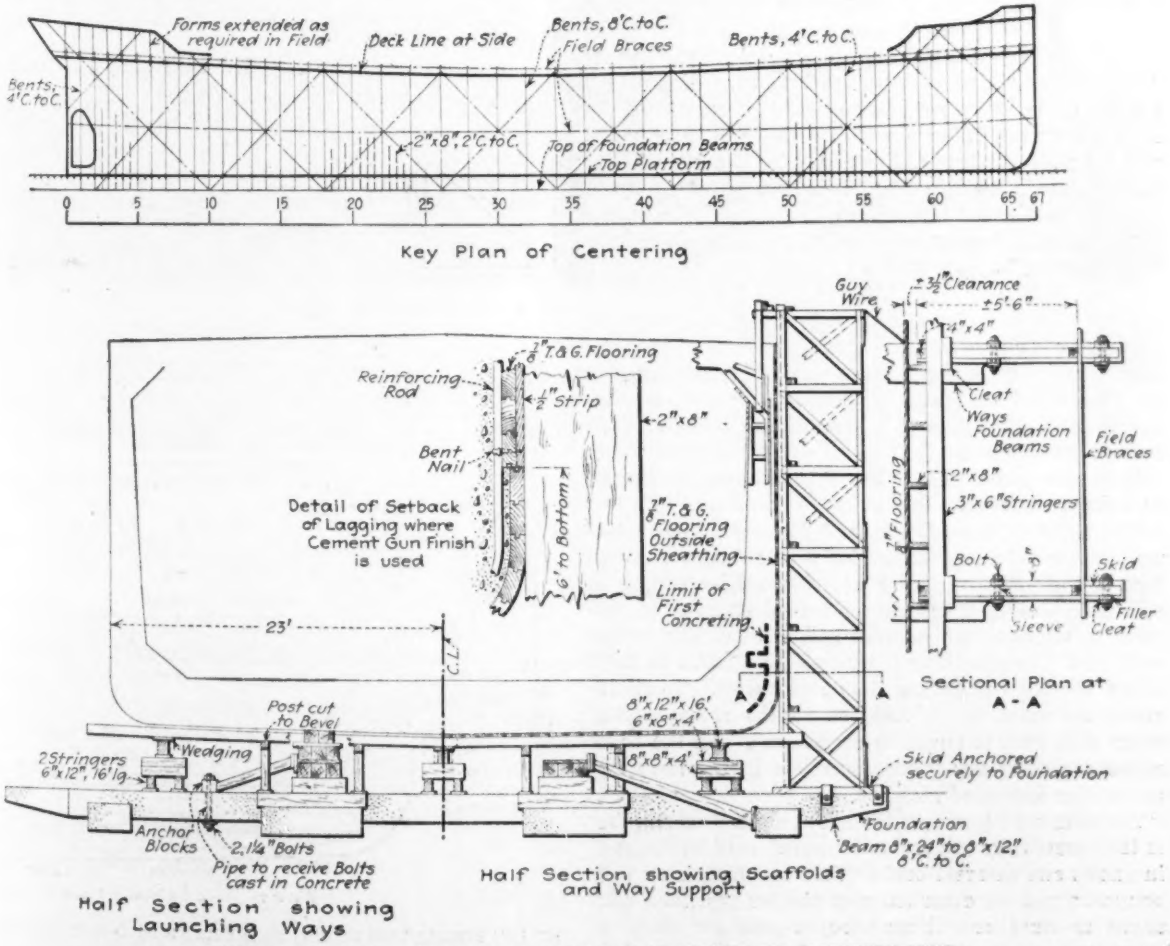
SHEET-IRON BAND AROUND DOGS PERMITS SMOOTH BENDING OF DEFORMED BARS

ways shown in the drawings and in some of the views consist of a shore section of four longitudinal concrete girders carrying transverse reinforced-concrete beams, the whole being sloped $\frac{5}{8}$ in. per foot to the front. The concrete beams were provided with bolt holes to which the forming and trestling of the ship could be attached. The outshore end of the ways are of timber on wood piles. Both sides of the ways were approached by an industrial track connecting to the other parts of the yard and to the concrete mixing plant immediately alongside of the ship. Each concrete tower is provided with a derrick for handling material over the ship.

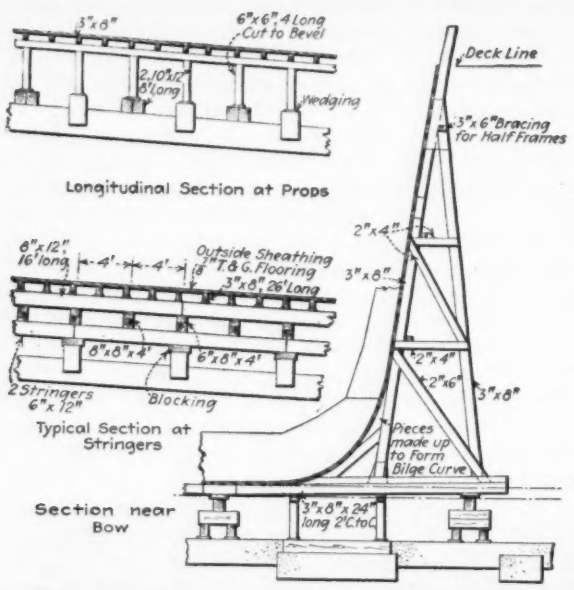
The first operation in the erection of the forms is in the placing of the floor. A continuous platform of 2 x 8 in. floor-beams was carried from the bow of the ship to about 20 ft. aft of the stern post, resting on the concrete ways. These platform beams were set at a pitch corresponding to the dead-rise of the ship and in general 2 ft. on centers, except that at every 16-ft. interval the beams were doubled up on account of the stripping of the bottom sheathing, which is made in 16-ft. panels. Under the bulkheads the floor-beams were set 1 ft. on centers for 4 ft. on either side. The platform was carried on shoring consisting of three longitudinal sets of stringers and four 6 x 6 in. stringers carried on 6 x 6 in. posts 4 ft. on centers.

As illustrated in one of the drawings, provision is made for setting the launching ways between the two rows of 6 x 6 in. posts.

The falsework carrying the side sheathing is made up in two general schemes. About one-half of the vessel's section is rectangular, except for the dead-rise and a 3 ft. radius of bilge. For the length of this section, then, transverse bents 5½ ft. wide and 34 ft. high



DETAILS OF OUTSIDE FORMS AND FLOOR SUPPORTS ON FOUGNER SHIP



CURVE OF SHIP REQUIRES IRREGULAR FRAME FOR FORMS

are set 8 ft. on centers. These are carried by, and securely bolted to, the concrete ways. The bents are set perpendicularly to the pitch of the ways, and are thoroughly braced to each other by means of longitudinal and cross-bracing on the outer sides. At the inner sides, longitudinal stringers are carried at each panel point. These stringers carry the 2 x 8-in. upright studs set 2 ft. c. to c., so as to meet the platform beams. At the bilge a segmental filler is nailed directly to the upright and the platform beams. The sheathing consists of ⅞-in. T. & G. made up into 3 x 16-ft. shop panels, for the straight portion of the bottom and sides. Where the shell has marked curvature no attempt was made to keep the sheathing in shop panels.

At the fore and after portions the scheme of carrying the falsework for the sides is modified. Bents of triangular or trapezoidal section, conforming very nearly to the body lines of the section in question, are set directly on the platform beams 4 ft. c. to c. so that for every frame there is a corresponding bent. Half-frames are then obtained by framing upright studs between the bents. These bents are all securely braced to form a continuous trestle.

No mold-loft work is required for any of the falsework described above except for the final curves of the fore and after bents, which are obtained by nailing to the inner posts a filler piece or curved stud cut to conform to templets, which were laid out full size in the mold loft. The sheathing is then nailed directly to these fillers, thereby completing the outside shell. To secure additional stability, in addition to the cross bracing every fifth bent is guyed to the ground. All the bents above described are framed complete in the shop and erected by means of ginpoles.

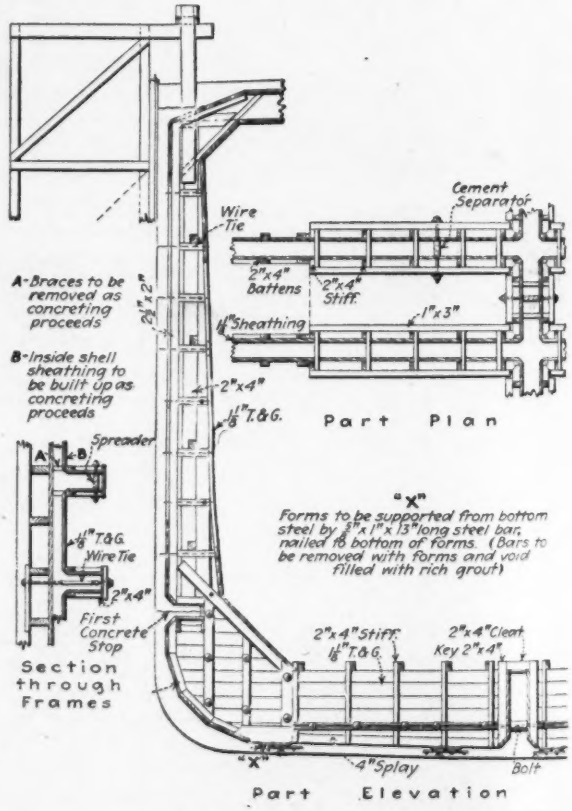
An essential feature of the above method of framing is that practically the entire centering may be stripped in panels and integral bents. This centering may then be used again for other ships of similar type, and with slight modifications it may be re-used for ships of other types or dimensions.

Inside Forms.—The inside forms may be divided into four general groups: (1) Forms for typical floors; (2) for tank-top floor; (3) for side frames and inside shell; (4) for deck.

The forms for the typical floors were made up as boxes in the shop. These boxes are keyed at the four corners by means of 2 x 4-in. keys. The pieces forming the splays at the bottom have no keys at their intersections, and no difficulty was experienced in stripping. To hold the boxes in position, when set, cross cleats are nailed to the 2 x 4-in. battens at the top, and ⅞-in. through bolts, with cement spreaders, are used at the bottom.

An essential detail is the use of the bolt stringers which hold the bottom bolts. When the bottom slab is poured, short, removable boards are spanned across the two 1 x 3-in. stringers, and the puddling and finish of the bottom slab is worked from these temporary platforms. The forms are supported from the longitudinal steel reinforcement by means of iron flats 13 in. long nailed to the bottom of the splay pieces. The results have been very satisfactory. The boxes are assembled and marked in the shop, and hauled and set as units. By shifting slightly the corner keys, any small variation required in fitting the boxes is readily taken up. Contrary to expectation, very little difficulty was experienced in fitting the boxes. All the inner panel forms have been stripped and no difficulty has been encountered, the boxes collapsing very readily, with practically no damage.

The carpenters were supplied with shop details for



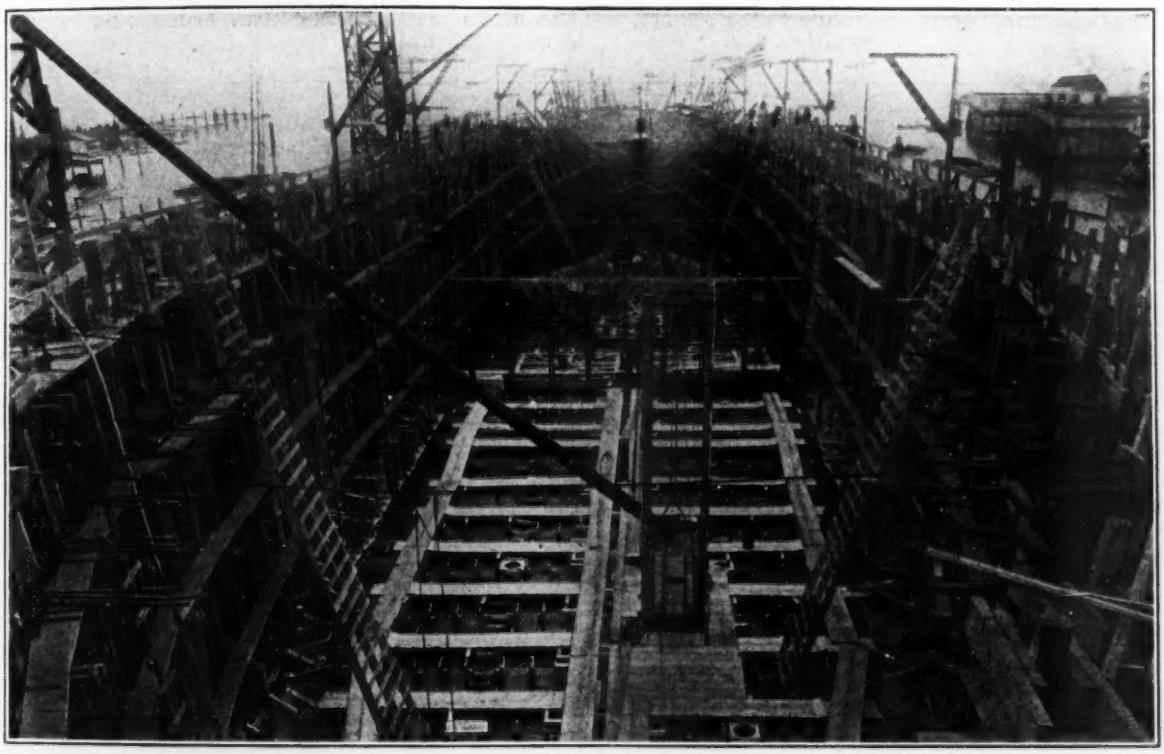
INSIDE FORMS FOR SHELL AND FRAME AND BOX FORMS FOR FLOOR

all the straight form work, but at the fore and after end full-size paper patterns are laid out in the mold loft. The tank forms are constructed similar to the typical floor forms. The tank-top slab itself was poured after the floor forms were stripped. The panels supporting the tank-top slab were made in sections, and are supported on skeleton frames. These skeleton frames are made up of 2 x 4 in. posts inserted in the bolt stringers, which are removed from the forms and used as headers in their respective panels. The panels supporting the slab are made so that they will readily pass through the tank-floor manholes when stripped.

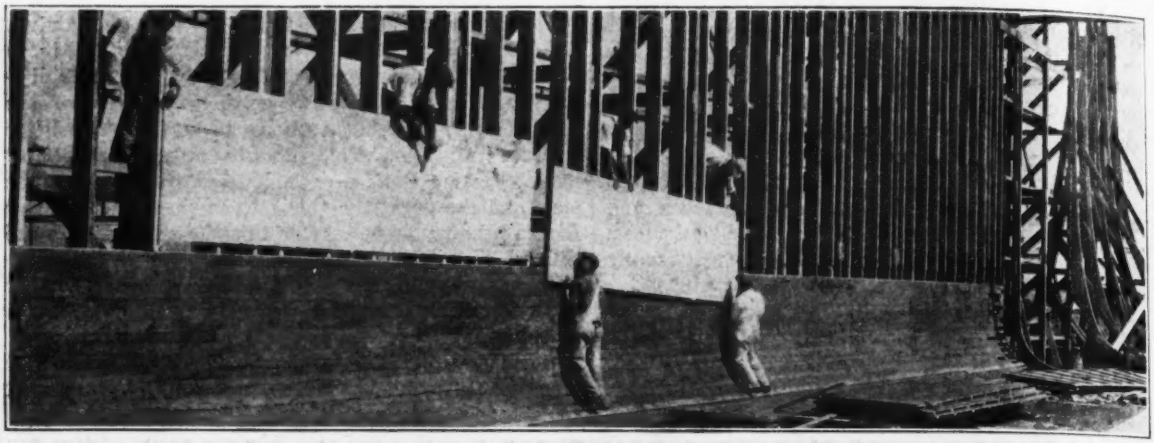
The side frames were all made in the shop and hung from cantilever braces extending from the outside bents. They are tied transversely by means of wire ties 2 ft. c. to c. For longitudinal bracing, through bolts and cement spreaders were used. The cargo battens were afterward bolted through these cement spreaders. The deck centering is similar to that used in ordinary building construction. The posts which carry the inside scaffolding used in concreting the sides are used also to carry their share of the deck forms, and are erected accordingly. The inside shell forms are in panels 2 ft. deep between frame forms, and are slid down one at a time, leaving one panel open for the pouring of the concrete in the shell.

Steel Placing.—At the time when the templets were made in the mold loft for laying out the outside forms, similar templets were made for each frame from which the frame steel was bent. The templets were taken to the steel-bending table, and the proper curve was laid out there. One of the views shows this bending table. It consists of 3 x 6-in. oak timbers spaced in 1 in. apart, the slots being used for the oak dogs shown in the view. Bending of the larger rods—that is, those up to 1¼ in. in diameter—was done on this table by hand. Some difficulty was found at first in getting the curve of the bend smooth, the tendency being to take the chord line between the dogs. This difficulty was obviated later by interposing a piece of ¼-in. sheet iron between the steel and the dogs, and this iron is shown in the view of the bending table. After this the curve of the rod follows the templet exactly, although some skill was required in knowing how far beyond the curve to bend in order to take up the elasticity of the steel. The smaller steel was bent in a manufacturer's bender.

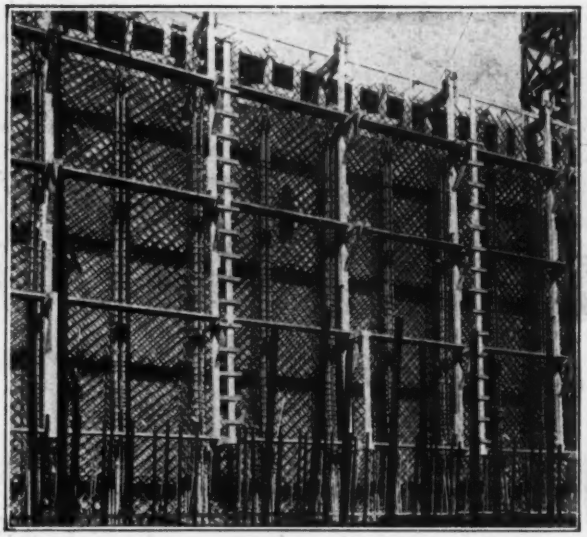
Some difficulty was anticipated in placing the shell steel so as to guarantee the necessary ½-in. concrete covering. It was decided to secure the proper placing of this steel layer by bringing in the outer form the ½ in. and tacking the outside steel directly to it. At a point 6 ft. above the bottom of the boat this inset was made, as shown on the accompanying detail sketch, by tacking a ½-in. strip to each vertical stud and continuing the tongue-and-groove lagging of the form panel against this strip. The outside rods then were tacked directly to these outside forms. At first staples were used, but later ordinary 8-penny nails bent over the rods proved to be easier to place. When the outer form is stripped the concrete will be flush with the outside of the steel reinforcement. A ½-in. coat of cement-gun mortar will then be shot over the entire outer shell of the ship. The contractor has successfully used the cement gun in casting the shells of a number of barges



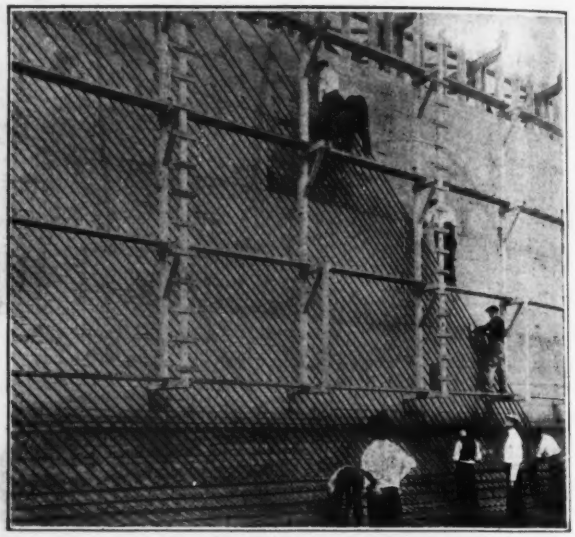
INTERIOR OF FOUGNER 3500-TON CONCRETE SHIP READY FOR CONCRETING FIRST RUN UP TO TOP OF BILGE CURVE. TWO MIXERS OUTSIDE FEED TWO INTERIOR TROUGHS FROM WHICH CONCRETE IS WHEELED TO PLACE



STRAIGHT SIDE FORMS ARE IN 16 x 3-FOOT PANELS. BILGE FORMS ARE NAILED ON CURVED STUDS AND HAVE TO BE DESTROYED IN TAKING DOWN

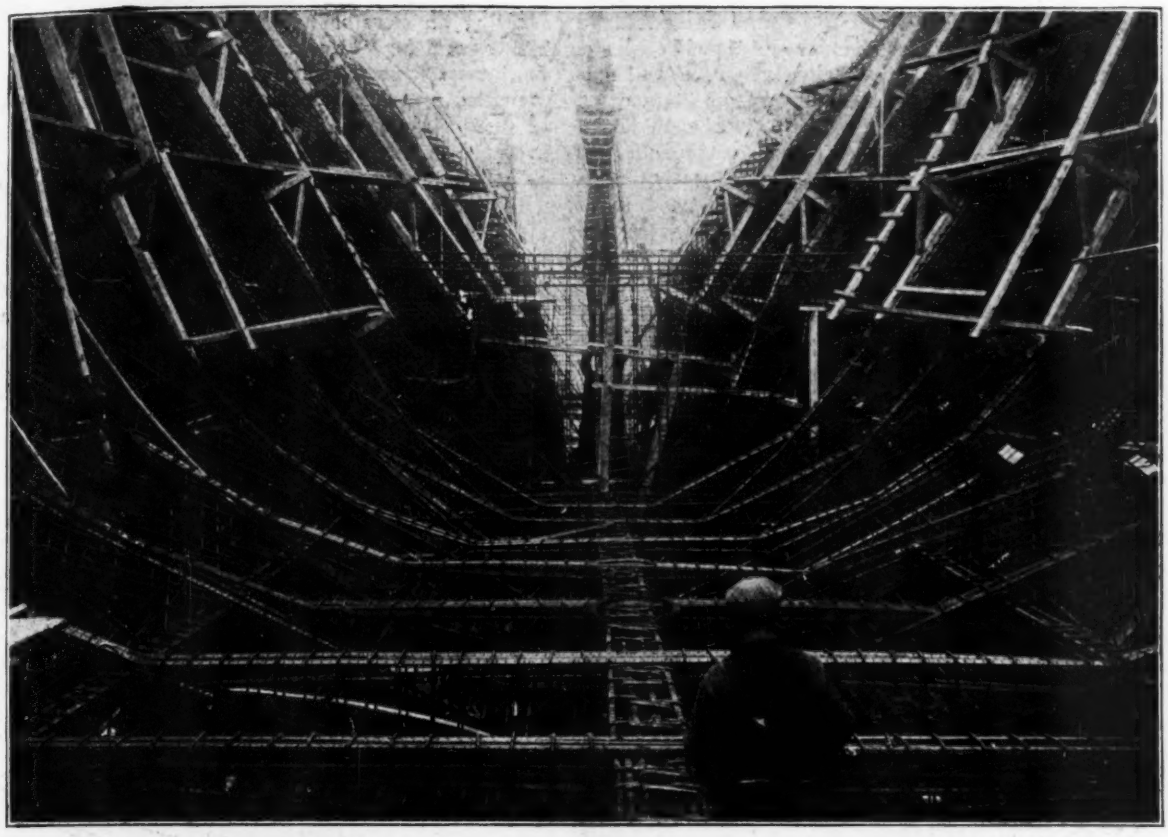


HANGING INSIDE TRESTLES ARE USED TO PUT UP INTRICATE SHELL REINFORCEMENT

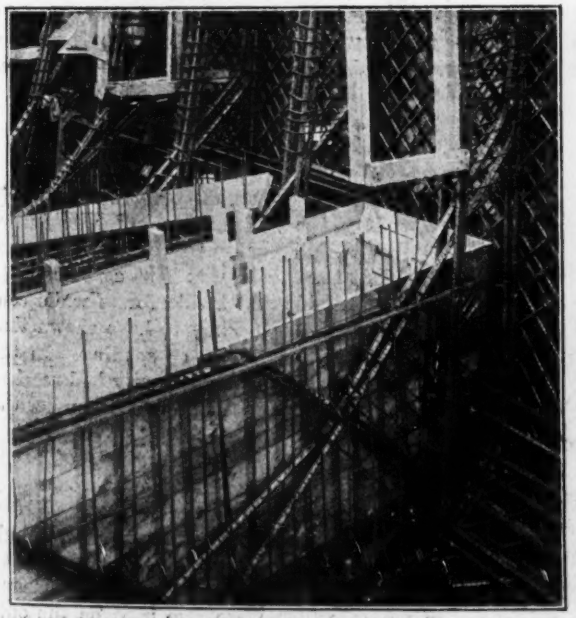


DIAGONAL OUTSIDE BARS NAILED DIRECTLY TO OUTSIDE FORMS AND BENT IN PLACE

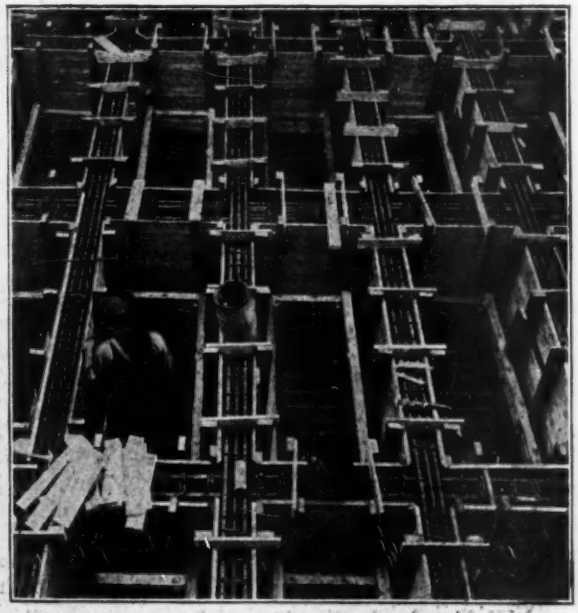
REINFORCEMENT PLACING STARTED BEFORE OUTSIDE FORM WORK WAS COMPLETE



NETWORK OF REINFORCEMENT AT STERN INVOLVED LABORIOUS DETAIL OPERATIONS IN PLACING



BOX FORMS AT BILGE ARE CUT VARYING WITH THE CURVE OF THE SHIP AT THE BOW AND STERN, AT EACH FRAME



BOX FORMS IN FLOOR NEARLY READY FOR CONCRETING. GIRDERS RUNNING ACROSS ARE KEELSONS; CLOSE SPACED GIRDERS ARE FLOOR FRAMES.

which he is building in his adjacent yard. Tests indicate that no difficulty need be feared in forming a satisfactory bond between the new and the old concrete.

The first operation of steel laying is to place the longitudinal floor bars. These are held up from the floor on precast concrete blocks 4 in. square and about 1 in. thick, with a ½-in. horizontal groove around all four sides to give a bond to the concrete subsequently placed. On the curve of the bilge a similar block 4 x 2 in. is used, but this block has a short piece of wire cast in it, and this wire, in the placing, is tied around the rod to prevent the slipping of the block down the curve of the bilge. The side rods being ½ and ⅝ in., these bars are not bent before being placed in the ship. They are put on in diagonal rows, as shown in some of the views, and can be bent directly around the curve of the bilge in the forms. They are spliced by wired overlaps in the floor of the boat. The bottom rods are not wired in their splices, but have a 30-in. overlap with a 4-in. hook on each rod. The bending of this 4-in. hook is quite expensive on the 1¼-in. rods. A special point of advantage in the Fougner boat is the 7½-in. thickness of the shell at the bilge. This gives somewhat wider leeway in the bending of the rods around the bilge, and does not require quite as careful work as though the bilge were of the same thickness as the shell and the floor. It does, however, add somewhat to the weight of the ship.

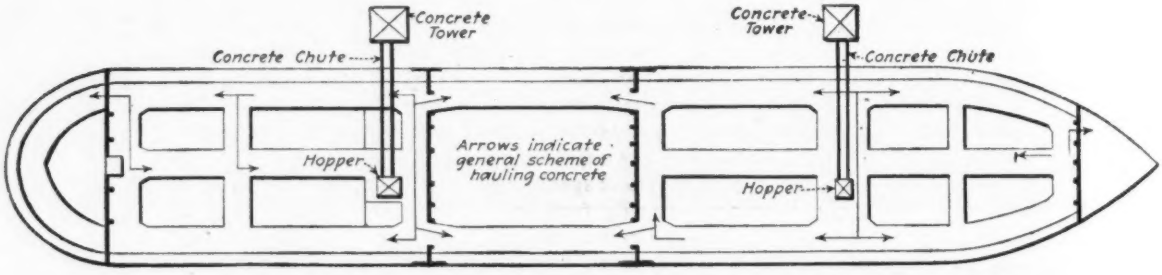
After all the floor steel is placed, the frame steel is erected and wired in place. This is very detailed work, as the network of the finished frame steel in one of the views will show. Great care is taken to keep the steel properly spaced, so as to permit the concrete to run around all the pieces.

Concreting.—The hull, up to and including the deck, is to be poured in three stages, each of which is one continuous operation. The first pouring was to the middle of the side stringers, the second to the middle of the top bracket of the side frames, and the third includes the main deck, the poop and the forecastle. The bridge deck, tank top, coal bunkers and shaft tunnel will be poured afterward, as convenient. The concreting has been carried successfully to the second stop, practically completing the hull up to the deck.

The first pouring, which includes the bottom floor system up to the middle of the side stringer at the 6-ft. water line, involved the placing of about 450 cu.yd. of concrete in 32 hours. Two ½-yd. mixers were set up at the quarter points outside of the ship at the base of towers which fed into a cantilevered chute from each tower. Inside the ship were two movable towers, each carrying an elevator hopper of about 2-yd. capacity. The general layout for wheeling and placing was one continuous runway encircling the ship near the sides, connected by transverse runways placed at the center of every other panel in the floor system. The layout is shown in one of the drawings.

There were two gangs of men on each of the hoppers, with sixteen men to each gang wheeling barrows. In the center of the frames and for the whole bottom, the concrete was dumped directly into the forms from the barrow, but in the side frames and the bilge shell galvanized-iron hopper chutes projecting out into the ship were provided. Concreting started at the quarter points and proceeded toward the bow and stern, and at the middle and proceeded toward the hoppers. A slow-setting cement was used, so it was possible to join up all the concrete before the initial set had taken place, and a continuous monolithic structure was obtained for the whole bottom and bilges.

The Emergency Fleet Corporation's special cement, 90% through a 200 sieve, was used on the work. The special light-weight burned clay aggregate of the Fleet Corporation could not be produced in time for this ship, so the so-called Steers' gravel and Cow Bay sand were used instead. This gravel consists of ¾-in. washed gravel mixed with 50% of washed coarse grit. The mix is 1 cement, ⅝ sand, and 1½ mixed gravel, giving a 1 : 2 concrete. Concreting started at 7 a.m., Nov. 6, and was completed at 5 p.m., Nov. 7.



LAYOUT OF PLANT AND RUNWAYS ON FOUGNER SHIP FOR CONCRETING OPERATIONS

With the steel closely spaced, difficulty was feared in tamping or spading the concrete in order to insure density. Instead, a full equipment of air hammers, provided with blunt-nose tools, was kept continually in action against the outside and inside forms while concrete was being poured. Experiments have shown that the effect is better than tamping or spading. In the actual operation, concrete which apparently had reached the full height of the forms settled 3 or 4 in. under the action of the hammers.

The second pouring involved the placing of about 350 yd. of concrete in 24 working hours, concreting starting at 7 a.m. Nov. 25, and ending 10 a.m., Nov. 26. Two stagings for the runways were used simultaneously; the upper for the wheeling and placing of the concrete, and the lower for the tamping by means of the air hammers, which were also used on the outside of the vessel at the same time.

The elevator hoppers already described were raised as required to the various stagings. Four gangs of four

men each were used in wheeling. The concreting was carried on from the quarter points, toward the bow and stern, and toward amidships.

The initial work on the ship was carried on with surprising rapidity, considering the fact that this was the first large vessel built at the yard. The first work on the floor forms was started Aug. 20, and the floor concreting was started Nov. 5. With the experience gained in this pioneer construction and with the forms, templets and machinery now available, the time and expense of building a second similar ship is considerably reduced.

The vessel was designed by the Fougner company, subject to the approval of the Concrete Ship Section of the Emergency Fleet Corporation, of which R. J. Wig is chief engineer. The Fougner Concrete Shipbuilding Co. is headed by Herman Fougner, president. C. P. M. Jack was retained as consulting naval architect. The design of the concrete hull and form work is in charge of Joseph Di Stasio, the designing engineer of the company. The marine work is handled by H. A. Christensen, and H. A. Hyman, the company's superintendent, has charge of the work at the yard. The Concrete Ship Section of the Emergency Fleet Corporation is represented on the work by Walter R. Harper, as resident engineer.

Principles Controlling the Layout, Marking and Maintenance of Trunk Highway Systems

Detailed Account of Methods Followed by Wisconsin Recently in Inaugurating a 5000-Mile System of State-Maintained Highways—Patrol System, Paid For by State, Is Administered by Counties

By A. R. Hirst
State Highway Engineer of Wisconsin
(Paper read before the Joint Highway Congress, Chicago, Dec. 12, 1918).

It is seldom that an engineer supervises the laying out, from the foundation, of a complete state highway system. Therefore, the experience obtained by Mr. Hirst in his work in Wisconsin will be of value to those who face a similar problem. The ideal system proposed was one interconnecting every county seat, affording access to the state's agricultural, scenic, manufacturing and resort interests, and connecting with the principal highways of the adjoining states. As soon as a highway was designated as part of the state trunk system, the state took over its maintenance, in this respect departing radically from the usual policy of undertaking maintenance only after the state has reconstructed a route. The results have fully justified this course, a 50% improvement over conditions existing at the start having been effected during the first season of control. The marking system adopted will also prove of interest to highway engineers and officials.—Editor.

THIS subject has been deemed worthy of discussion at this time because many states have laid out or are about to lay out state highway systems or state trunk highway systems.

One of the principal reasons why the American states have not yet secured a system of highways comparable to those in European countries is that, until very recently, the counties and states built highways without having in mind the building of any definite system, and the expenditures were scattered on so many roads, of varying importance, that the results have not been as apparent as the expenditures justified. It is becoming increasingly evident that, if our states are to have a completed system of modern highways within this generation, their expenditures must be largely concentrated upon definite and restricted systems of highways, and not spread indiscriminately on all roads, as in the past.

In order to make possible this concentration, the state highway systems must be most carefully selected, for this policy of concentration will meet much opposition, which opposition will in many cases prevail unless the basic layout is honestly, logically and adequately made.

I have ventured to discuss the principles which should underlie the creation of a state trunk highway system, because Wisconsin has in the past two years established such a system, and our methods of doing it and the lessons we have learned in the doing of it will doubtless be of interest to the states which have, or will shortly have, similar problems.

It is probably germane to state at the outset that the whole cost of establishing, marking, administering and maintaining the Wisconsin trunk highway system, and the state's share of the cost of all Federal-aid construction on it, are made available by appropriating 75 per cent. of the net proceeds of the motor vehicle license fees for these purposes. The remaining 25 per cent. goes back to the counties for the maintenance of other main roads.

What Should a State System Comprise?

The first questions which present themselves are, "What is a state trunk highway system, and what percentage of the public highway mileage of a state should be comprised in an adequate system?"

Our conception is that *a state trunk highway system is a system of highways interconnecting every county seat in the state, also every city or village having a population of 1000 or more; offering full access to the agricultural, scenic, manufacturing and resort interests located within the state; and connecting also with the principal highways of all surrounding states.*

We believe that the state trunk highway system should include approximately 10% of the total public highway mileage lying outside the limits of incorporated cities and villages. This percentage may be high for some of the more thickly populated states, and it may be low for the sparsely settled ones.

The present Wisconsin state trunk highway system, shown by the accompanying map, comprises 5000 miles, or about 6½% of our total rural road mileage. This system, however, is not entirely adequate; we expect that the legislature will add from 1500 to 2500 miles within the next few years, bringing it up to about 10%. In the sparsely settled sections of Wisconsin the present system comprises 10% of all road mileage, and in the fully settled and partly settled counties it comprises about 6%. It passes through 71 out of 71 counties (100%); 728 out of 1242 townships (58.6%); 120 out of 125 cities (96%) and 157 out of 253 incorporated villages (62%). The aggregate population of the cities, villages, and townships through which the system actually passes is 81% of the total population of the state.

State Trunk Highway System Should Be Generous

We are convinced that a state trunk highway system should be generous rather than niggardly. Objection may be made that the more miles there are in the system the longer it will take to construct it. We doubt the force of this objection. In practically every state the construction of a complete state trunk highway system with adequate, modern types of pavement must wait upon bond issues. We believe it is much easier to pass a bond issue in the average county, or in the average state, to build an adequate system of highways, than to build one that is inadequate. It will usually be easier to bond a county for $3,000,000 to build an adequate system accommodating the great majority of the people, than to bond it for $1,000,000 to build a smaller system accommodating a minority. On a larger scale the same principle is true for states. Human nature is still human nature, and men still largely vote for that which directly benefits them, and vice versa.

Summing up, therefore, we believe that the state system should consist of an adequate mileage accommodating, as far as through lines of intercounty communication are concerned, all the people in every section of the state. Usually it will require 10% of the road mileage of a state to accomplish this result, but this figure is subject to increase or decrease, varying with the degree of development of the state or its sections.

Selecting the System

We have already stated that any state system, to be successful, must be honestly and fairly selected. It follows, therefore, that the selection should be largely in the hands of disinterested engineers—subject, however, to review by a fair tribunal and made only upon the fullest knowledge of all roads which are proper candidates for positions upon the system.

In our state the selection was made jointly by the State Highway Commission and a committee of five from the legislature, appointed by the Governor. There was complete coöperation between the two bodies, and we believe that the result reached jointly was much more satisfactory to the people of the state than action by either body alone would have been.

Probably the best way to outline the methods which we believe should be used in selecting a system is to give briefly the methods we used in Wisconsin.

The first step in the layout was to select and place upon a map all roads in the state which, from the best available information, were the main lines of travel. These were studied very carefully, and another map was made showing a tentative system, including the most desirable routes but not exceeding the maximum mileage allowed by the statute. These highways were strategically located so that parallel highways were placed a reasonable distance apart, and so that the areas untouched by any road were approximately equal in territory of equal development. As a result of this very careful preliminary work, it was found that the tentative system coincided largely with that finally selected.

After this had been done our division engineers made a careful reconnaissance survey of all the routes on the map, together with competing routes, where such existed, and such other routes as seemed to them to be worthy of consideration. This survey was made by automobile; the division engineer, who drove the car, acted as observer, and was assisted by a recorder who kept a record of all features of the road by tenths of miles on a prepared pad sheet. The features recorded included the character and condition of the road and its surface, culverts, bridges, drainage, soil, the character of surrounding country, cheese factories, creameries, school houses, farm houses, mail routes, railroad crossings, turns, hills, bad conditions generally, and all other information of engineering and public interest. The actual mileage on the various routes was, of course, taken. By tabulating these sheets it was possible, in case of doubt between two competing routes, to get a very close idea of their comparative merit. It is unnecessary to go into further details of the methods used in this survey, especially since they have been described in various publications.

The cost of this automobile reconnaissance survey was about 80c. per mile of road. The accurate knowledge it gave us of the physical condition of each road was well worth the cost. Incidentally, in the later hearings we were often enabled to confound, with the extent of our precise information, local partisans who claimed not wisely but too well.

Hearing at County Seats

After all probable routes had been surveyed, hearings were held at each county seat. Large-scale maps showing the routes under consideration in the county and vicinity were displayed, and the advocates of all routes, especially the competing routes, received full opportunity to present their views. As evidence of the interest in the layout, most of these county hearings were attended by from three to six hundred persons and much valuable information was obtained. The important result, however, was that the people knew that all possible routes had been investigated and that the advocates of all of them had received a fair chance to be heard.

After a series of hearings covering a particular section of the state, the State Highway Commission and the legislative State Trunk Highway Committee, which sat jointly with the commission in many of these hearings, met at Madison and determined the official system

MAP OF WISCONSIN'S 5000-MILE STATE TRUNK HIGHWAY SYSTEM SHOWS ROUTES AND ROUTE NUMBERS

for that section. Important considerations in arriving at the final layout were the population served, the grades, the supply of materials locally available for construction and maintenance along the various roads, and the transportation facilities available where local materials were not to be had. In many cases the choice between competing routes was determined by the character of the soil over which the two passed. Where one road was largely on good clay soil, for instance, and the other lay largely in sand, the clay route was usually selected because of its greater ease of maintenance, and because, naturally, it usually served better farming territory. Wherever two routes of equal general value were in competition, the one which served the most local purposes was the one selected.

It is interesting to note that in repeated instances

routes entirely different from the ones formerly used were discovered and established with great advantage. Railroad grade crossings were avoided whenever possible, and by changing established routes we were able to eliminate dozens of grade crossings from the routes of through travel, without expending an extra dollar. Travel often gets accustomed to using a certain route and retains it long past the time of its superiority.

In laying out the 5000-mile system in Wisconsin about 7500 miles were surveyed. About five months were required by all the necessary operations, and the total cost to the state was approximateely $20,000, or at the rate of $4.00 per mile for each mile finally located on the system, including the cost of the final survey (described hereafter) made in the spring of 1918.

Condition of System

Maintenance was taken over by the counties under the general direction of the state on May 1, 1918, as required by law. As early as possible in the spring of 1918 a second survey of the lines as finally established, connected and numbered was made. This survey was for the twofold purpose of recording the condition of the highways by tenths of miles at the minute when state maintenance began, and for the second purpose of determining the location of the mile posts and patrol sections, the information to be placed upon the direction and danger signs, and their location, etc. This second survey was made in the same general manner as the first, but, due to experience gained in the first survey, it required less time, and, though probably more information was gained, the cost did not exceed 65c. per mile.

We feel that a condition survey is necessary at the exact moment when the maintenance of the system is begun—first, to obtain an accurate measurement of the system as finally laid out, and, second, to make a record of the exact condition of the system so that improvements made can be later registered and compared with the original condition.

We have worked out a system of progress reports using colored crayon and tack entries on charts and maps, so that the past and present condition of any section of the system and all structures on it can be determined at a glance. It is impossible to describe the details of this record system, but we shall later publish a full description after it has been fully developed.

Tabulation of the Condition Survey

A tabulation of this final condition survey (made as of May 1, 1918) shows that there were actually 4999 miles of road on the system subject to state maintenance. Of this 167 miles (3.34%) were deep sand; 2363 miles (47.29%) earth in good condition, 535 miles (10.70%) in poor condition; 1001 miles (20.02%) of good gravel surfaces, 126 miles (2.52%) of poor; 573 miles (11.46%) of good macadam, 102 miles (2.03%) of poor; 120 miles (2.40%) of concrete; and 12 miles (0.24%) of other superior surfacing (brick, sheet asphalt, etc.).

Roughly summarizing, we took over 702 miles (14.0%) of sand and poor earth roads; 2363 miles (47.3%) of good earth roads; 1706 miles (34.1%) of various surfacings in good condition, and 228 miles (4.6%) of various surfacings in poor condition. A road or surface was classed as "good" when it was in condition to be maintained by ordinary patrol methods, as "poor" when it required extensive repairs or reconstruction before it could be so maintained.

We also took over 9904 culverts, divided as follows: Concrete 4140 (42%); stone 1050 (10%); wood 1164 12%); steel and miscellaneous 3550 (36%), and 1951 bridges (water structures over six feet in span) divided as follows: Reinforced concrete 393 (20%); stone 199 (10%); wood 324 (17%), and steel and miscellaneous 1035 (53%). Culverts, therefore, averaged two per mile of road, and bridges 0.4 per mile of road.

There were on the system 617 grade crossings, 20 overhead crossings and 21 undergrade crossings with railroads and interurban railways.

It may safely be said that we took over "some job!"

(To be continued)

Engineering Education Affected by War Experience

Dr. C. R. Mann Discusses Future Changes Due to War Training — Effects Upon Academic Standards

SPEAKING before the Boston meeting of the Society for the Promotion of Engineering Education, Dr. C. R. Mann announced some of the results of war training methods and discussed the vital problems which now confront the engineering colleges of the country, suddenly relieved from the duty of handling the Student Army Training Corps and facing the necessity for getting back to a routine peace basis. Without attempting to go into details, he indicated the steps which he believes to be most likely to lead by experiment to sound conclusions. The principal points brought out by Dr. Mann follow:

On Apr. 10, 1918, 10,000 young men were called to the national service by the War Department and placed in schools for two months of intensive military and technical training. By June 15, 50,000 men were in training at 155 schools. This number was continued through the summer, and 25,000 men, prepared for service as technicians in the Army, were graduated each month. Before the signing of the armistice, 130,000 men had been so trained and contracts had been let for training 220,000 more.

Made Careful Survey of Army Needs

Before beginning this instruction, a careful survey was made of the needs of the Army, to determine the specifications for every job for which soldiers were to be trained. The shopwork was then planned to teach each man to do the particular job for which he was best adapted and for which he was to be held responsible in the Army organization. The instruction consisted of a series of projects carefully graded in difficulty and requiring for their accomplishment the exercise of ingenuity and resourcefulness.

In like manner, the humanistic work was designed to answer the many questions asked by the soldiers

concerning the issues of the war. The class work in these war issues courses was a continuous discussion of these questions, and it was accompanied by outside reading. Some 40,000 questions of soldiers were collected, sorted and classified, and a brief manual was issued containing the questions most frequently asked, together with references to documents in which answers might be found. Propaganda for any point of view was avoided, the men being helped to discover the facts which would enable them to draw their own conclusions. The course was given by the coöperation of all the best men in the different departments involved.

Technician Training Highly Successful

Military officers state that after two months of the combined training the men made as good progress as is ordinarily the case after two months devoted to military training alone in the cantonments. In the shopwork the men acquired skill and understanding of their problems at an amazing rate. Bank clerks, barbers, salesmen and others who had never worked with tools before have been converted into satisfactory technicians for Army use. The war spirit, the reality of the work, the progression from application to theory, and the snap of military discipline, have all joined in producing results that before the war were pronounced impossible by the schools.

In the experiment of training young men for officers' training camps in the Students' Army Training Corps in colleges considerable difficulty was developed in adjusting the military with the academic routine. Nevertheless, 85% of the schools have just expressed their desire to retain the system to the end of the present academic year. Unfortunately, this cannot be done, because the removal of the military necessity makes it impossible to utilize sufficient appropriations.

Reorganization of Industrial Production

The reorganization of industrial production is a task requiring a type of engineering ability that is at present very rare. It is the function of the technical schools of the future to develop men who can and will accomplish this intricate task. At present the curricula are not designed to secure this result, because their avowed aim is to impart knowledge of the laws of physical science and of the properties of materials. If we are to accomplish this task, we must add to this knowledge an understanding of the methods by which human wills are coördinated for team play, not only in individual organizations, but also in national enterprises.

The larger outlines of the coming industrial system are now emerging from the toil and turmoil of the war. When the war began everyone was certain that it could not last long, because the bankers would stop it. Now everyone recognizes that the fighting continued so long as adequate supplies of men and material were maintained. This means that national strength in war depends upon the production of men and supplies rather than on the financial system. Therefore engineering, not banking, is the foundation of democracy's power.

The war has also indicated the methods by which engineering schools can train engineers competent to meet successfully the heavy responsibilities that are now theirs. This experience seems to indicate that the following are the steps most likely to lead by experiment to conclusions of sound merit:

1. The War Department's experience with training soldiers shows that the first essential of effective teaching is a clear definition of the result desired. To place emphasis on production rather than on knowledge of the laws of physical science, new specifications of the essential factors will have to be written. This may be done from a study of the actual operations of engineers in productive enterprises, or by joint action of national engineering societies.

Knowledge Developed by Specific Tasks

2. The content of the courses and the methods of instruction must be organized in such a way that every fact presented and every problem solved is relevant or contributes obviously to the acquisition of some information or the development of some power required or mentioned in the specification. Knowledge is always specific and is developed best by mastery of specific tasks.

3. Real military training and discipline have been demonstrated to be an essential element in the training of every engineer. The purposes of the military machine are to keep men physically fit and to train them so that each willingly subordinates his own individual desires and efforts to a common purpose to be achieved by the entire group. Therefore careful consideration must be given to the question of how much military training is desirable, or what better substitute, if any, can be found to accomplish the same all-important results.

4. The Army has long recognized that soldiers are better fighters if they have an intelligent conception of the issues of the battle. This was inculcated by the war issues course. Would the introduction into engineering curricula of a similar course, dealing with the issues of peace, be the best method of solving this intricate problem for engineers? The humanistic needs of the engineer are not satisfied by the current practice of requiring several years of linguistic training and brief courses in modern history or economics. Would not a course in which the wealth of material in history, in literature, in art, and in philosophy was focused upon the modern burning issues of peace prove to be a most effective way of broadening the outlook of men who are specializing in the highly technical branches of applied science? In order to facilitate experiments along these lines, the War Department has arranged to supply the schools with materials dealing with the peace conference, the formation of a league of nations, and the reconstruction of our industrial system.

Rating and Testing Methods

5. The final large contribution of the war experience to educational practice has been made in the field of rating, testing and classifying men by objective methods. The Army test for general intelligence has been found a most valuable method of selecting and classify-

ing men for all sorts of Army work. In one hour's time this test yields results which correlate so highly with the results of many months of personal experience that all recruits are now required to take it when they enter the service. The War Department was about to require that all students in the Students' Army Training Corps take this test. The sudden demobilization of the corps necessarily interrupted this experiment, but it is believed that the schools will find it a most useful one to carry further.

The Committee on Education and Special Training, Washington, D. C., is prepared to supply the necessary blanks and instructions.

Objectve Tests as Incentives

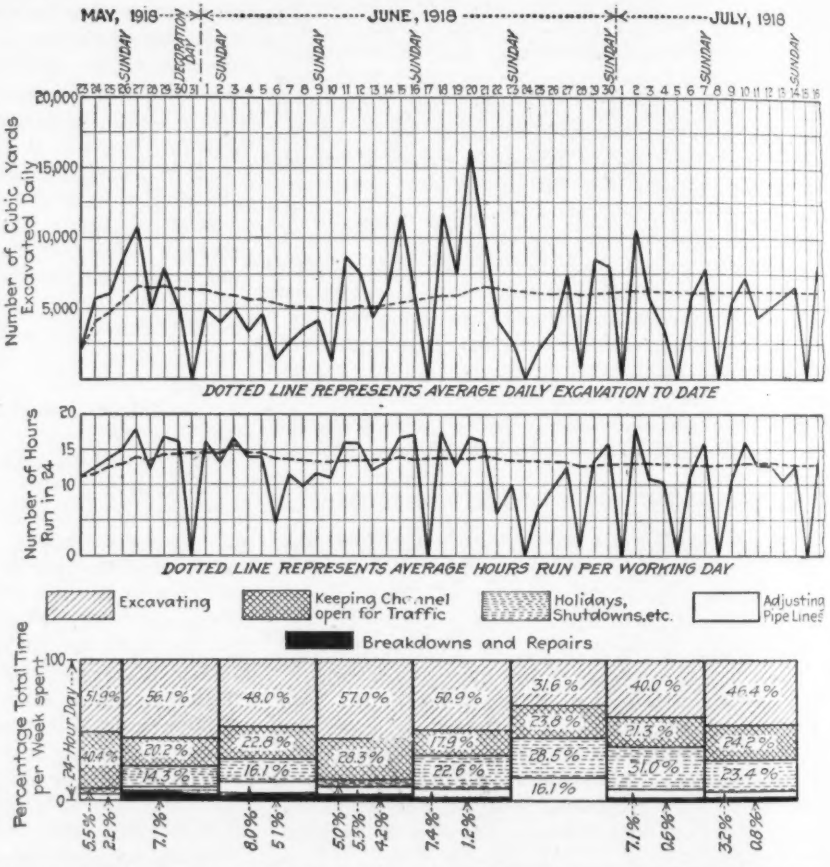
The use of tests as an incentive to good work and as a means of releasing creative energy has been recognized but little. Certain it is that students understand full well how to "get by" examinations as now given. On the other hand, the test of the football field commands their profound respect, because it is an objective "show-down" in competition with men who are recognized as leaders. The new Army tests are also objective. They open to the schools great possibilities of using their testing machinery as an incentive to spirited work rather than as a sieve for misfits.

6. Perhaps the most striking fact of the War Department's experience with education is that the Federal Government was willing to spend $200,000,000 in one year on education. No such single appropriation for education was ever made in this country before. The reason is very simple. The national need was great, and the schools had proved by their training of soldier mechanics that they could be relied upon to meet the national need. The primary purpose of the training was that each individual might be better equipped, not to realize his own personal ambitions but to serve the nation more effectively. The experience points to the conclusion that the public is ready to spend unlimited funds on education, provided it is obvious to the taxpayers that thereby community, state, and nation are being effectively served.

Lehigh Valley Visualizes Performance of Dredge with Chart

TO HELP him to visualize construction performances, G. T. Hand, chief engineer of the Lehigh Valley R.R., uses a chart of the type shown. This happens to be a performance record of a 20-in. hydraulic dredge working at Newark, N. J. It began work May 23 with three 8-hour shifts daily, and on the basis of 250,000 yd., the total estimated yardage to be removed, had 87.2% of the work completed June 30.

The chart is made on cross-section tracing cloth, from which blueprints can be made. On the left side, under "General Remarks," is a table, a few days of which are reproduced. On the right most of the same data are shown graphically by a series of diagrams, some of which are here shown. The use of different colors in the percentage diagram makes its meaning clear at a glance.

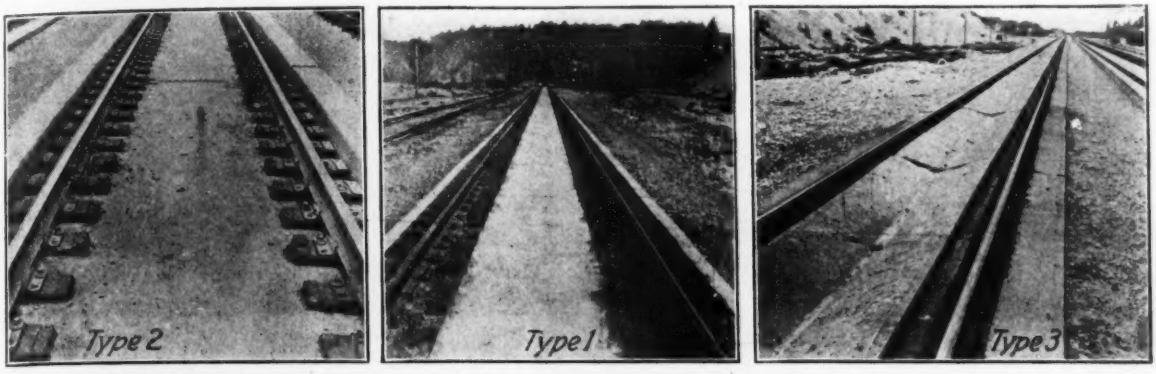


DATE DAY ENDING 8.00 P.M.	DAY	CUBIC YARDS EXCAVATED DAILY	KIND OF MATERIAL	No. HOURS WORKED IN 24 Hrs	Min.	AVERAGE YARDAGE PER HOUR WORKED	TOTAL EXCAVATION TO DATE	PERCENTAGE OF TOTAL EXCAVATION COMPLETED TO DATE cu. yd. 250,000 Basis	cu. yd. 500,000 Basis
May 23	Thu.	2274	Blue Clay and Mud Mixed	11	05	205	2274	0.9%	
" 24	Fri.	5833	Quick Sand and Blue Clay	12	20	473	8107	3.2%	
" 25	Sat.	6120	" " " " "	13	45	445	14227	5.7%	
" 26	Sun	8520	" " " " "	15	00	568	22747	9.1%	
" 27	Mon.	10,800	Quick Sand, Oyster Shells & Blue Clay	18	00	600	33547	13.4%	
" 28	Tue.	5040	Sand, Oyster Shells & Blue Clay	12	10	413	38587	15.4%	
" 29	Wed.	7875	Red Clay, Oyster Shells & Sand; some Blue Clay	16	50	469	46462	18.6%	
" 30	Thu.	5102	Blue Clay, Sand; some Red Clay	16	10	315	51564	20.6%	
" 31	Fri.	(Shut Down for Weekly Lay-off. Making General Repairs)							

DAILY OUTPUT, TIME AT WORK, PROGRESS OF JOB AND OTHER DATA SHOWN BY BOTH TABLE AND DIAGRAMS

Concrete-Base Track Gives Good Results on Northern Pacific Railway

New Type of Construction Four Years in Actual Service—Concrete Slabs Built on Gravel Roadbed Have Wood Supports for Rails—No Ballast Used—Maintenance Work Not Continuous but Intermittent



NORTHERN PACIFIC RAILWAY IS EXPERIMENTING WITH CONCRETE-SLAB ROADBED DESIGNS

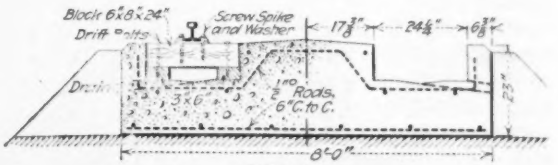
CONCRETE roadbed or base support for railway track on open line, as distinct from its use in tunnels and passenger terminals, has had its most extensive application on the Northern Pacific Ry., where a 2000-ft. stretch of double-track main line with concrete-slab roadbed and no ballast has been in service for four years, with results that are in general satisfactory so far as maintenance and cost are concerned. The experimental concrete-base track is on the line between Tacoma and Tenino, Wash., and was built by company forces in June-September, 1914, during the original construction of the line.

This radical departure from the universal type of track and roadbed construction includes three variations of one general design. A continuous single-track concrete slab with wood supports for the rails is the basic feature of this design. Thus, resilience of track and cushioning of the rails are provided in all cases, and there is no placing of rails directly upon a rigid concrete base.

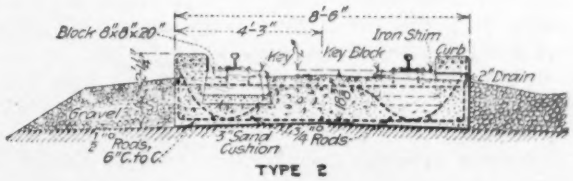
The live load used in designing the slabs was a 26,000-lb. wheel load on two ties, with 100% allowance for impact. Allowable compression and shear in the concrete were assumed as 250 and 50 lb. per square inch, respectively; tension in the reinforcing steel as 12,500 lb. Short transverse wood blocks in the slab form the rail supports in two designs, while the third employs continuous longitudinals or sills. In two designs, also, the slab is so shaped as to form continuous guards or curbs to keep the wheels to the track in case of derailment.

This new type of track construction is located in a long and wide gravel cut. The excavation was finished carefully to grade, so as to avoid backfilling, and after the surface had been well tamped the concrete was placed directly on this roadbed, bottomless forms being used. The material might be classed as fair gravel ballast, although a small proportion of clay led to its being abandoned for ballasting purposes. The settlement has been very slight, except that one slab at the end of the cut and partly on a fill settled at its fill end.

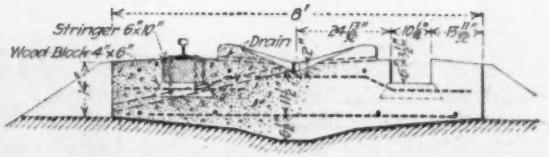
An 8-ft. concrete slab, 24 in. deep at the middle and having two recesses or troughs for the reception of wood blocks carrying the rails, is the construction used for type 1, which is laid for 594 ft. of single track. This is shown in one of the accompanying drawings. Reinforcing rods are laid in both directions in the bottom and top, the upper transverse rods being bent to the approximate shape of the top of the slab. The recesses for the rail blocks slope longitudinally to side drains or weep holes. Joints are provided at intervals, the slabs being poured in lengths of 16 ft. 5½ in. and separated by 9/16-in. expansion joints, filled with hot 1:4 asphalt-sand mastic. The ends of the slabs are



TYPE 1



TYPE 2



TYPE 3

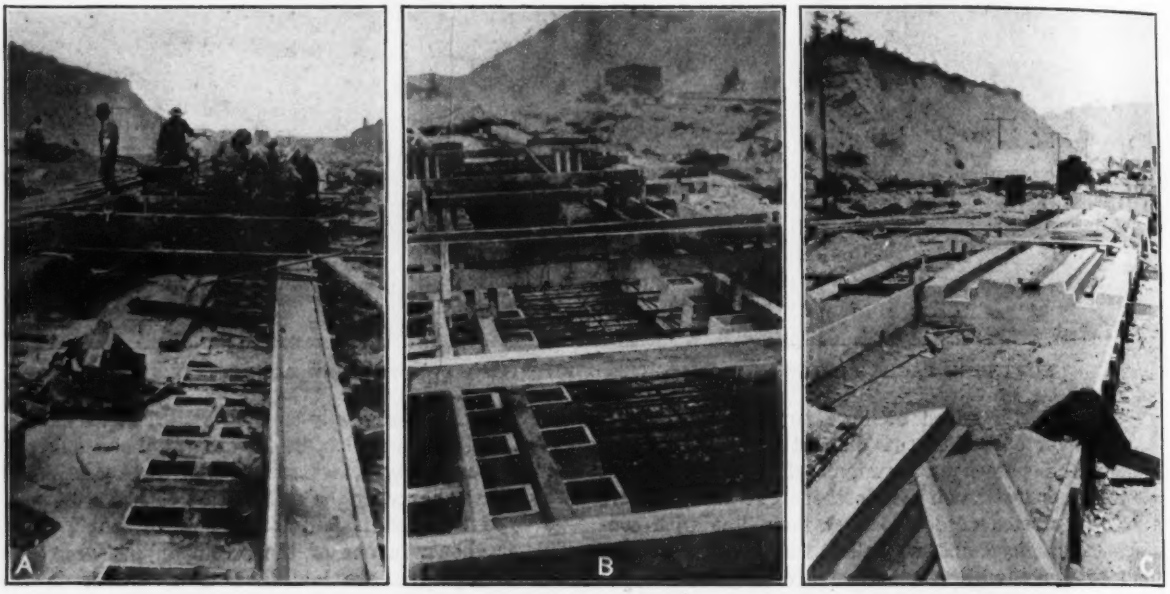
THREE TYPES OF CONCRETE SLABS FOR TRACK CONSTRUCTION ON THE NORTHERN PACIFIC RAILWAY

mortised 6 in. for a width of nearly 3 ft., in order to prevent independent lateral shifting.

Creosoted fir blocks having their tops flush with the top of the slab form the supports for the rails. They do not rest directly on the concrete, however, but each line of blocks is laid on a pair of creosoted fir sills. The purpose of the latter is to afford additional cushioning and anchor the blocks both as to position and as to line and surface. They also allow more convenient replacement than would be the case if the blocks were cast into the concrete slab. Each block is driftbolted to the sills. The blocks are spaced 16¾ in. on centers, except that at the rail joints this spacing is reduced to 11 in. Standard 90-lb. 33-ft. Northern Pacific rails are laid on steel shoulder tie-plates and fastened to the wood blocks by screw spikes with clips which rest on the tie and rail base. The rails are laid with square joints, spliced with four-bolt 24-in. angle bars.

Concrete curbs or parapets on the outer edges of the slab are distinctive features of type 2, as shown in the drawings. This also is laid for 594 ft. of single track. The slab is somewhat wider, 8½ ft., on account of the curbs, but is only 16¾ in. thick at the middle. Its curbs are 8 x 11½ in., with drain holes at intervals. In this case the slab is in lengths of 32 ft. 11 in., with 1-in. expansion joints filled with asphalt mastic. The width of mortise is only 28 in. Separate pockets instead of continuous troughs are provided for the creosoted blocks. Each block rests on a 3-in. cushion bed of sand in the bottom of the pocket and is secured by a wedge or key block driven at its inner end.

Lining and gaging of track are provided for by malleable iron shims set between one end of the block and its pocket. One of these shims is L-shaped, with its top resting on the block and secured by a small nail. In the face of this is a horizontal opening to receive additional shims, as shown in one of the detail drawings. The track construction is similar to that previously described, except that the blocks at the joints have the same 18-in. spacing as the others, while deep bridge plates carry the rail ends over the space between the ties. Pockets have to be made in the surface of the concrete to clear the webs of these plates. Rails are laid to break joint 12 ft. They are laid on hook-shoulder tie-plates, and secured by cut spikes on the inside, while screw spikes fasten the plates to the wood blocks. Gravel ballast is laid along both sides of the slab as a protective covering for the roadbed.



CONSTRUCTION WORK ON CONCRETE SLABS. A. PLACING CONCRETE; IRON POCKET FORMS AT LEFT. B. WOOD FORMS AND STEEL RODS IN PLACE. C. ALTERNATE SLABS ARE POURED

Sand filling is used in the pockets to afford additional cushioning and to provide means of adjusting the track to line and surface in case of settlement of the slabs or wear of the rail. However, it has been decided to use in resurfacing a bitulithic filling, partly because the slabs have reached a final settlement and partly to exclude water from the pocket. Presence of water in these pockets has caused the sand to pump or shift with the movement of the blocks under traffic, so that it will be necessary to resurface this strength of track shortly. Scarcity of labor has delayed this work.

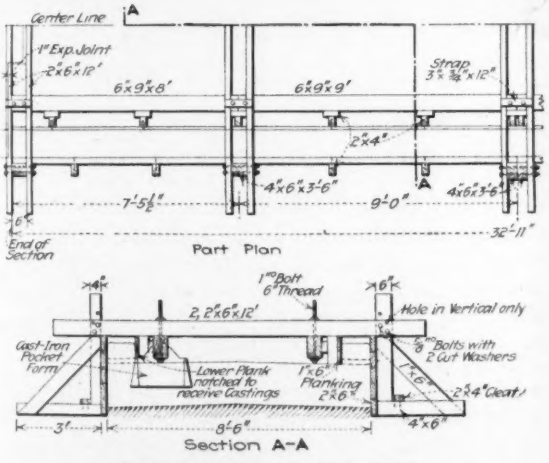
To surface track of this second type, the inside key blocks are removed on a length sufficient for a day's work, and the rails, with tie blocks attached, are jacked up high enough for working. The sand is then removed from the pockets and any water also removed, after which the bitulithic mixture is placed to a depth of about 3 in. and leveled to the grade necessary for a true surface of the track. The blocks and rails are then lowered upon this bed and the keys are replaced. Traffic may be allowed to pass over the track as soon as this is done. The operation may be repeated if necessary, until the track is in proper surface.

Longitudinal timber supports for the rails and inside curbs or guards on the slab are the characteristics of the third and longest of the three experimental stretches of concrete track construction, which extends for 810 ft. of single track. The slab

is 8 ft. wide, dished on top to form a drain between the guard ribs or curbs, and having a depth of 18 in. at the middle. With the guards on the inside, or between the rails, the width of slab can be made less than where they are on the outside, as in the second design described. In this third design the slabs are in lengths of 16 ft. 5½ in., separated by ½-in. expansion joints filled with hot asphaltum. The ends of the slabs are straight and butted together, instead of being mortised.

Creosoted fir timbers 6 x 10 in. form the longitudinal bearings for the rails. To prevent them from shifting or creeping they are fastened at intervals by long lag-screws driven into wood anchor blocks which were embedded in the slab when the concrete was poured.

No tie-plates are used in this case, the rails being laid directly upon the longitudinal timbers. There has been very little wear of the wood under the rails, however, and this does not exceed ⅛ in. in depth. It varies on individual timbers and increases slightly at the joints, but in most cases it amounts simply to compression of the surface fiber. The fastenings are screw spikes whose heads bear directly upon the rail base, no clips being used. To support the rear side of the spike head, and thus afford reinforcement against lateral thrust, a crescent-shaped washer is used, placed with its ends fitting against the rail base. Creeping of the rails upon the longitudinal timbers has been found to occur, although the track is heavily anchored and the timbers themselves do not creep. For this reason it

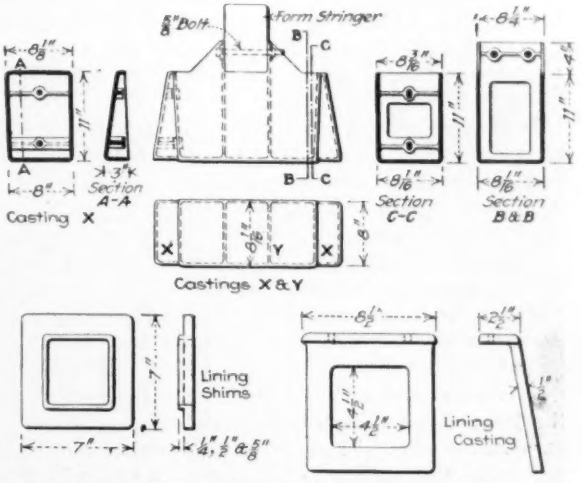


FORMS FOR SLAB OF TYPE 2

has been necessary to cut the longitudinals at intervals and apply rail anchors, which bear against the cut ends and thus prevent movement of the rails.

Preparation for the construction of concrete roadbed for the second design, with the slab laid directly upon the roadbed, consisted in dressing the subgrade to specified shape and placing the side forms. These were braced by outside brackets, as shown in one of the drawings. The side forms were connected at the ends and at intermediate points by transverse members, each consisting of a pair of planks carrying saddles with suspension bolts for a pair of stringers to which the forms for the inside of the curbs were attached. These stringers were placed after the slab reinforcement was in position.

The pockets for the tie blocks were made by means of cast-iron forms, the outer surface of the metal being rough-ground sufficiently to give a surface that would draw readily from the concrete. All surfaces of wood and of castings that would come in contact with concrete were cleaned and soaped before each pouring.



IRON FORMS FOR POCKETS IN SLAB AND IRON SHIMS FOR RAIL BLOCKS

Each pocket form consisted of three parts, the two smaller end pieces being wedge-shaped to give the dovetailed form of the pocket. These parts were fastened together by thumbscrews, and the main or central casting had lugs for a horizontal bolt by which it was fastened to the wood stringer of the top form.

To remove the forms, the nuts on the stringer suspender bolts were run up to allow the raising of the cross pieces 4 in., these pieces then being secured in this new position by bolts through the tall posts of the side forms. After the side blocking of the curb had been removed and the thumbscrews had been released, so as to free the main part of each pocket form, the nuts on the suspender bolts were screwed down carefully. This raised the stringers and pulled the castings vertically out of the slab. The side castings of each block were then taken out, and were attached to the main casting at once to prevent their loss and make the form ready for use again.

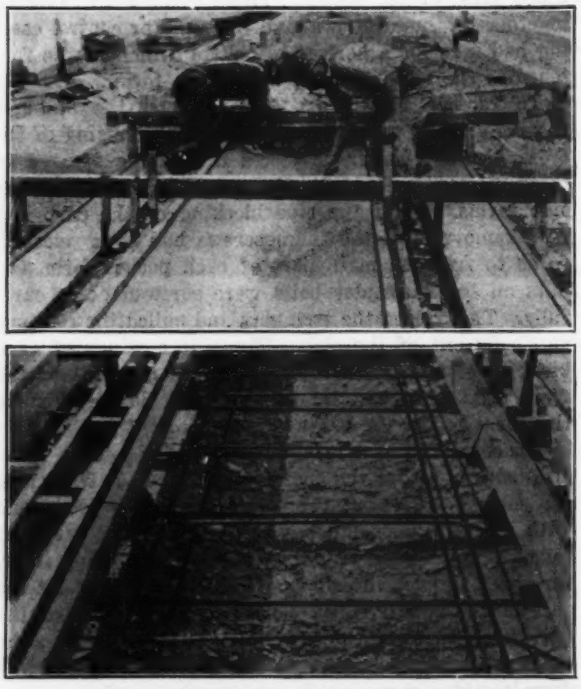
The concrete was a 1:3:5 mix, gravel of ¾-in. to 1½-in. size being used for the coarse aggregate. It was made wet enough to fill out the forms and get a good bond with the reinforcement, but at the same time care was taken to avoid such an excess of water as would interfere with the float-finishing of the top surface. At the rail-joint locations, the concrete between three of the pockets was troweled out to clear the bridge plates, the drain holes being lowered correspondingly. The pocket form castings were withdrawn as soon as the concrete had set sufficiently, and were never allowed to remain in place more than 24 hours. The roadbed was sprinkled to prevent absorption of water from the concrete.

To place the track 3 in. of sand was put in each pocket. The rail blocks were set on this, the key blocks being omitted. Then the plates and rails were placed,

but the rail spikes and screw spikes were omitted. A heavy engine was run back and forth along this track until all the blocks were thoroughly settled into place, relining and resurfacing being done where necessary. Then the inside key blocks were driven. If this did not make the rail blocks tight, the iron lining pieces were placed on the outside. Finally, at each tie-plate the two screw spikes were driven to hold the tie-plate, and a cut spike was driven to hold the rail. The method of resurfacing and of replacing the sand with a bitulithic filling has been noted above.

It is asserted that each of these three types of concrete roadbed and track construction has given satisfactory results, although some minor difficulties have developed. These difficulties have been mainly in regard to creeping of rails. In the light of practical experience, it is understood that certain changes would be introduced in any future construction of the system. No extension is contemplated. The traffic averages six passenger and five freight trains each way daily.

As to the cost, the engineers explain that from the way in which the work was done, in three short pieces, the first cost cannot be taken as applying to construction on a larger scale. The service has been too short for any definite figures as to the labor and cost of maintenance. There is very little difference in the maintenance of the different types, but the type having the rails supported on timber longitudinals maintains the best surface and line. It is said that all of the three



FORM WORK AND FLOAT FINISH FOR ROADBED

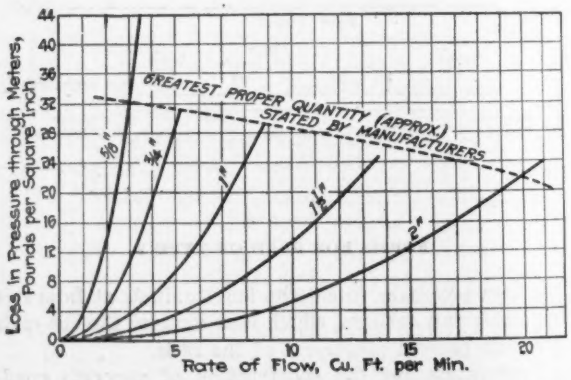
designs of concrete support give a more smooth-riding track than the adjacent tracks having crossties and ballast. The maintenance cost has been very slight so far, probably only 5% of that for the adjacent tracks of ordinary type. From the character of the new construction it is evident that expenses for maintenance and repair are likely to be concentrated at intermittent periods rather than distributed evenly year by year.

This track experiment with concrete base was initiated by W. L. Darling, who was chief engineer at the time the new line was built, in 1914. The designs were prepared by the engineering staff and have not been patented. The service performance of the track has been under the observation of L. M. Perkins, engineer maintenance of way (now corporate engineer) and H. E. Stevens, chief engineer, Northern Pacific Railway.

Water Meters Should be Selected with More Care

Loss of Head Varies Greatly with Different Makes—Right Choice Saves Money—Plumbing Adjustments Help

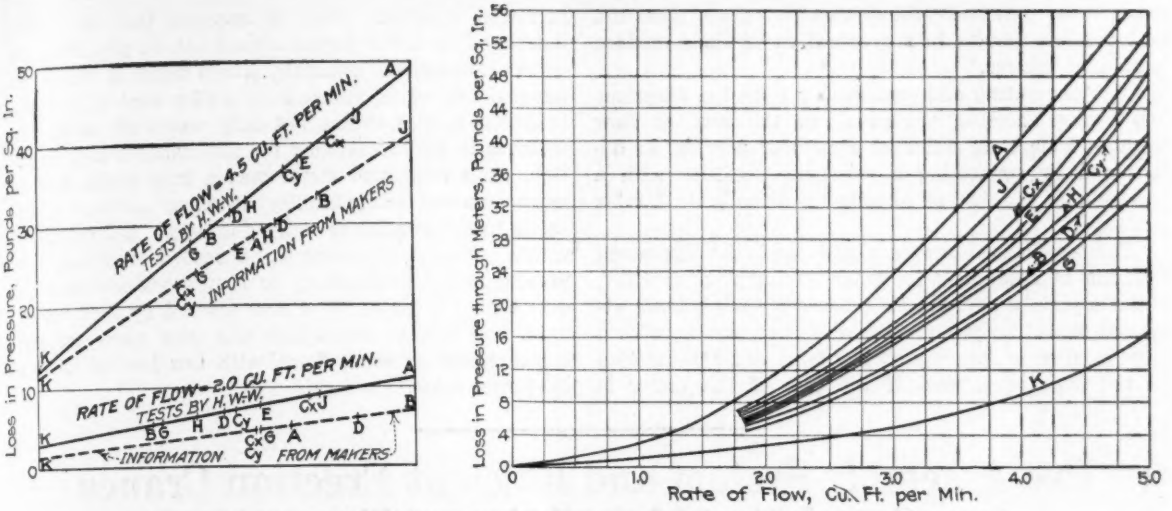
NEED for more care in choosing the sizes and types of water meters to be used under various conditions of service was shown in a paper by Caleb M. Saville, chief engineer of water-works, Hartford, Conn., in a paper read Nov. 14 before the New England Water-Works Association. Numerous diagrams and tables were presented. These were based on studies and actual tests of meters made at Hartford under the direction of Mr. Saville, as well as upon information supplied by meter manufacturers. A considerable part of the paper, and many of the tables and diagrams, dealt with special studies of rates of flow in service pipes, for which an automatic rainfall register was adapted to serve as a recording mechanism, by an electrical connection with the counter of a water meter. The adaptation was made, at Mr. Saville's suggestion, by J. E. Garratt, office engineer of the Hartford water-works. The paper will be published in the *Journal* of the New England Water-Works Association. A sum-



MANUFACTURER'S RATING OF LOSS OF HEAD IN ⅝- TO 2-INCH WATER METERS OF SAME MAKE

mary is given here of the portion of the paper relating to the selection of water meters.

Before taking up his main subject, Mr. Saville called attention to the apparently inevitable increase in the rate of water consumption, which should be taken into account in choosing the size of the meter to be installed. At the same time, Mr. Saville also pointed out, careful design of plumbing, including the choice of fixtures using large quantities of water in a short time, such


Loss in Pressure, Pounds per Sq. In.
RATE OF FLOW = 4.5 CU. FT. PER MIN.
TESTS BY H. W. W.
INFORMATION FROM MAKERS
RATE OF FLOW = 2.0 CU. FT. PER MIN.
TESTS BY H. W. W.
INFORMATION FROM MAKERS
Loss in Pressure through Meters, Pounds per Sq. In.
Rate of Flow, Cu. Ft. per Min.

LOSS OF HEAD IN ¾-INCH STANDARD WATER METERS OF VARIOUS STANDARD MAKES

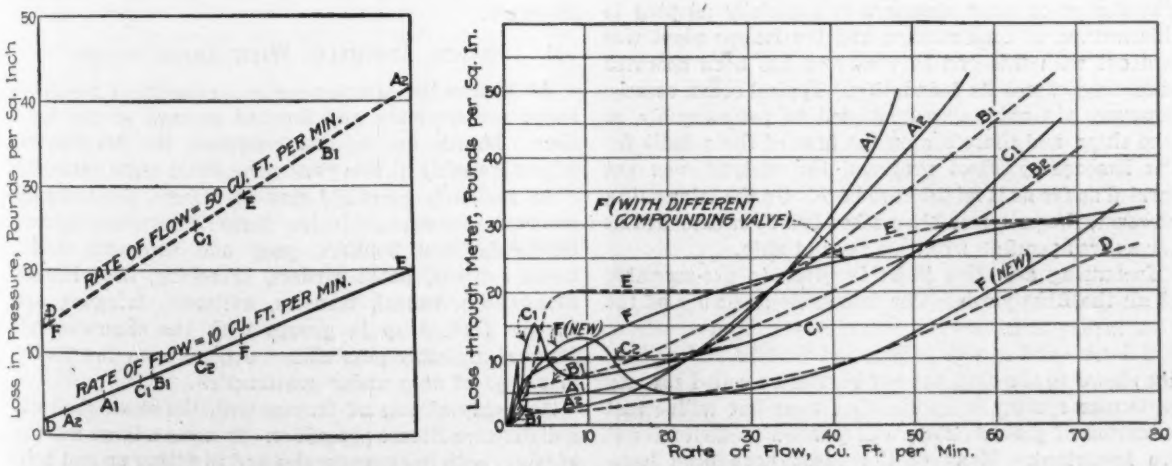
For high and for low constant rates of flow on the left, as tested by makers and by Hartford water-works, and on right, for varying rates of flow, as tested at Hartford

as water closets, and also including the size of service pipes and of large rising pipes leading to the class of fixture indicated, might be far more economical in the longer run than the use of larger meters; that is, he urged in effect that it may be cheaper to reduce loss of head by using larger supply pipes than to effect the same end by putting in larger meters, due to the well known fact that the cost of meters, particularly of the larger sizes, increases out of all proportion to the mere increase in the size of diameter of the meter.

At the beginning of his paper Mr. Saville said:

"So far as accuracy of registration and durability go, there seems little to influence the choice between any of the meters now put on the market by the half dozen or more reputable manufacturers. As regards loss of head, however, meters of different makes now on the market show considerable variation. It easily may be that a smaller meter of one make, therefore of less cost, will do the work as efficiently as a larger and more costly meter of a different make."

Taking the manufacturers' assertion that the proper rate of flow for a 1-in. disk meter is about 8 cu.ft. per minute, and the manufacturers' rating of loss of head per square inch for different makes of meters, it appears that at the rate of discharge mentioned one make of meter loses 19 and another 31 lb. per square inch of pressure. A 1-in. meter of the first make would therefore perform the required service as well as the 1½-in. meter of the other make, at relative costs of $20 and $40. Using similar data and reasoning, a 3-in. compound meter costing $160, of one make, would be just as satisfactory in point of loss of head or volume of water passed with a given loss of head as a 4-in. meter of another make costing $260. Although the difference in cost between ⅝-, ¾- and 1-in. meters is less than between the larger sizes, yet many more meters of the smaller sizes are used than of the larger, so that great economy might result to the water department by choosing the make of meter which gave the lowest loss of head. In addition, Mr. Saville said, "consumers are


Loss in Pressure, Pounds per Sq. Inch
RATE OF FLOW = 50 CU. FT. PER MIN.
RATE OF FLOW = 10 CU. FT. PER MIN.
Loss through Meter, Pounds per Sq. In.
F (WITH DIFFERENT COMPOUNDING VALVE)
F (NEW)
Rate of Flow, Cu. Ft. per Min.

LOSS OF HEAD IN VARIOUS MAKES OF 3-INCH COMPOUND WATER METERS

For constant rates of flow on the left, as tested by makers and by Hartford water-works, and on right, for varying rates of flow, as tested at Hartford

much better satisfied with service that gives them the best possible results in the operation of their modern plumbing fixtures."

After presenting and commenting upon the diagrams and tables showing variations in the rate of flow through meters on different classes of service, as determined by connecting a rain-gage recorder with a water-meter counter, as already mentioned, Mr. Saville said:

"The conditions shown above, and the expressed opinions of specialists in water consumption matters, indicate plainly that the time has come when more attention should be given to the design of meters, with a view to greater accuracy on low flows and less friction on the high ones, even if the cost of the meter is increased thereby. Also, it appears that too much 'tolerance' in meter design should not be permitted by water departments, especially where water is filtered or pumped and every unnecessary gallon sent to the distribution system means not only waste of water but increase in the annual cost for maintenance and operation. The compound meter was a long stride toward more accurate accountability on those services where there are intermittent calls for large quantities of water. What now seems to be needed is redesign of present meter mechanism, or a new water-measuring device for use on services now covered by disk meters 2 in. and less in size which will give more accurate measurement of small flows, with less loss of head at the larger rates."

Pre-Assembly System and Efficient Erection Cranes Speed Up Shipbuilding at Ecorse

Pre-Assembly is Extending Rapidly in Lakes Yards—Reduces Erection Labor on Hull—Thorough Application at Ecorse Helped in Making "Crawl Keys" Record

PRE-ASSEMBLY of ship parts has been developed as a special feature by the Ecorse yard of the Great Lakes Engineering Works. It is given main credit for the remarkable achievement may by the yard recently in launching the 3500-ton ocean-going steamer "Crawl Keys" after 14 working days and completing it in 29. C. E. Baisley, superintendent of the Ecorse yard, said: "We believe that the secret of speed in building ships is to assemble as many parts and as large sections as possible, off the berth. Without this assembly we could not have built a boat in 14 working days."

Efficient ship-erection plant contributes essentially to rapid shipbuilding at Ecorse. The berth layout and the type of crane used result in direct, short-distance travel of the material to the ship—a factor in developing full efficiency of the crane and reducing time loss on the berth.

Originally, pre-assembling of material on the building berth was developed in connection with the building of the ore steamers typical of the Great Lakes fleet. The design of these steamers is especially adapted to this method of construction, and the Ecorse plant was laid out with this end in view and has been operated accordingly since its foundation. Typical ocean vessels, however, are not as well adapted to pre-assembly as lake ships, and therefore on the first of those built for the Emergency Fleet program, the method was not carried as far as it might have been. On the later ships, however, the pre-assembly method has been extended as far as was possible with this type of ship.

Increasing attention is being given to pre-assembly at all the Lake yards. The inevitable assembly of the plate-girder members in the ship's bottom—keelsons and floors—and of web frames and the like, before they are placed in the ship has not heretofore called for any particular system of special facilities; but with great extension of pre-assembly, well planned facilities for it are important. Many of the yards have been hampered, in applying pre-assembly, by lack of storage space for fabricated material and lack of assembly space close to the ship. This condition is being remedied in new berth layouts. At the Wyandotte (Mich.) yard of the American Shipbuilding Co. a special building for the assembly work has just been put in service—a new and radical improvement. The Manitowoc Shipbuilding Co. is erecting a similar shop in its yard at Manitowoc, Wis.

It has been almost universal practice hitherto to use the fabricating shop only for punching, countersinking and rolling, and to carry out all the sub-assembly work on floors, frames, stringers and the like in the open, even on parts of the berth space during the early stages of the ship erection. When the work must be so scattered, and especially when there is no space for finished storage alongside the ship, full development of pre-assembly is discouraged. But since the present shipbuilding rush made it increasingly clear that large advantage could be gained by extending pre-assembly to a maximum, all the yards have worked consistently forward in the direction of increasing the amount of their pre-assembly.

Frames Assembled With Sheer-Strake

At Ecorse the erection-crane arrangement furnishes space for assembly and finished storage at the same time. Mainly due to this condition, the development of pre-assembly at this yard came about quite naturally.

As regularly practiced now at Ecorse, pre-assembly covers the following principal items: Floors, web frames, bulkheads, coal bunkers, poop and forecastle decks, hatch sections, hatch girders, breeching, deck houses, foundations, tunnel, transom, keelsons, stringers, and frames (bolted up in groups with the sheer-strake). Further assembly possibilities depend upon the particular type of ship under construction.

Assembly of sets of frames with the sheer-strake is a distinctive Ecorse procedure. It saves a large amount of labor, both in crane service and in fitting up and bolting on the ship. A length of the upper side plate, or sheer-strake, 24 ft., is assembled with its twelve frames,

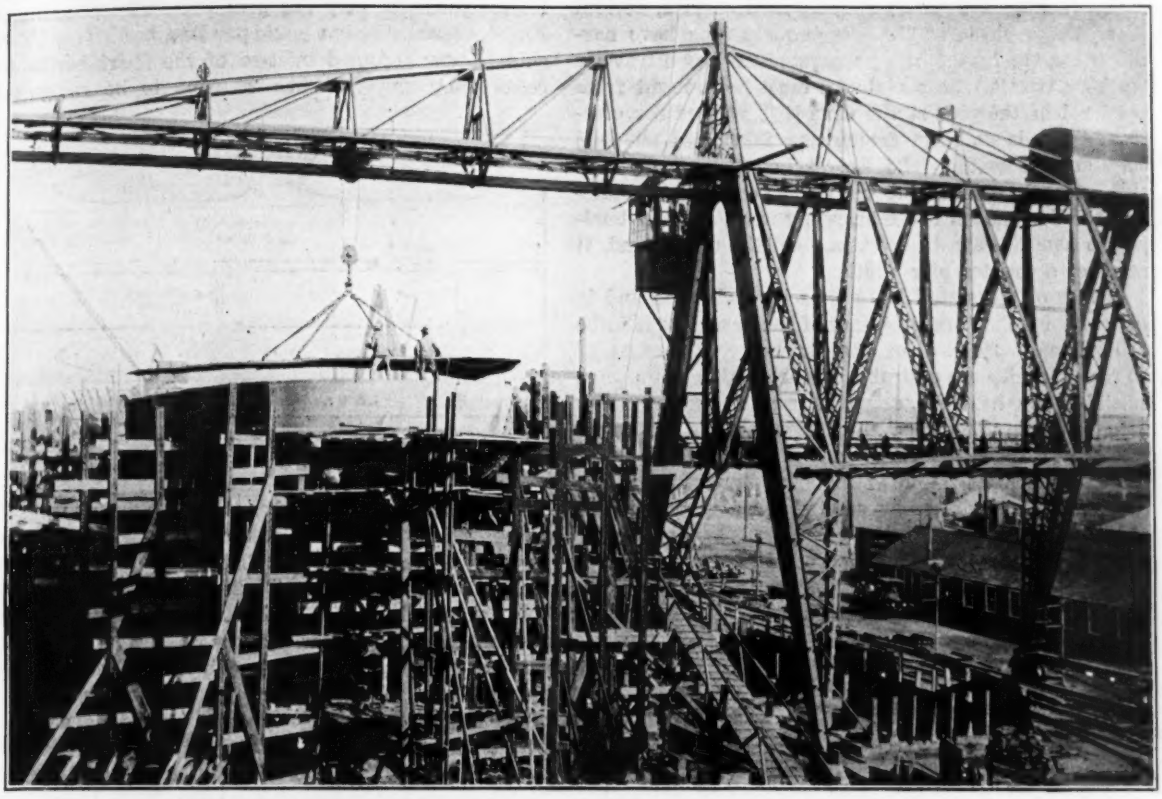


FIG. 1. ASSEMBLY OF LARGE SECTIONS AT ECORSE—POOP DECK BEING SET AS A UNIT

each frame being tacked to the plate by a few bolts. Usually, all the frame sections for the middle body of the ship are made ready in advance, and piled close by the ship (Fig. 2). Only a single handling is required for swinging such a section to place, so that the framing of the ship can be built up rapidly to the stage where plating can proceed. While the process of frame assembly does not reduce the amount of riveting on the ship, it simplifies the erection work to such a degree that it may be considered the outstanding feature of ship erection at Ecorse.

Both speed and economy of shipbuilding are served by pre-assembly. With steel and labor shortages affecting the yard operation and with the shop capacity limited (under single-shift working) to a supply of 400 tons monthly to each berth, the gain in speed is not a vital factor in getting maximum production, but it proves valuable when delays in erection occur on individual berths and must be balanced up. Economy and simplification of the yard system are every-day advantages, however.

Laid out along the sides of slips about 800 ft. long extending into the yard area at right angles to the shore line, the eight shipbuilding berths at Ecorse occupy one full pier and two half piers, down which the ship material is transported from the fabricating shop lying along the head of one of the slips. Side launching is used, as in all the Lakes yards, the berths running parallel to the sides of the piers. Each berth is about 80 ft. wide, and its full width is covered by the cantilever arm of a gantry traveler (Fig. 1), running on a track just back of the berth and parallel to it (longitudinal to the pier). The space between the gantry rails, 60 ft. wide, is used for assembly and finished storage.

An average case of arrangement of material and assembly work alongside the building berth is diagrammed in Fig. 3. A standard-gage track near the rear rail of the gantry track enables locomotive cranes and material cars to reach any part of the berth length, so that a single handling is sufficient to place material in storage directly opposite the point where it is required in the ship, or where it is to be assembled. Plate racks and storage for floors, frames and the like are provided in part of the space between the track rails. The rest of the space is left free for assembly.

FIG. 2. FRAMES BOLTED TO SHEER-STRAKE—PRE-ASSEMBLED UNITS STORED IN CRANEWAY

Contrasting with the arrangement described, several other Lakes yards of the pier-and-slip type have narrow piers, the berths being separated only by a traveler track or trestle. Ship material must be brought from the head of the pier at the time it is wanted for erection; there is no room for storing fabricated material close to the berth. The Ecorse layout, by providing such storage, reduces the tax on the cranes and equalizes the demand on the fabricating shop, thereby tending to avoid delays in erection. On the other hand, it requires a greater pier width.

Cranes of adequate lifting capacity and speed and in sufficient number are necessary if pre-assembly is to be utilized most fully. For the Ecorse work, cranes of 10 tons capacity are desirable, in the opinion of the yard officials. The heaviest assembled parts in the ships now being built do not exceed about eight tons. Fast crane motions also are important with pre-assembly, because the advance preparation of material enables a greater tonnage of material to be erected for a given amount of berth labor.

Under the demands of rush work in emergency shipbuilding, the need for increased crane equipment has made itself felt quite generally. Until recently the Ecorse yard had only the gantry cantilevers shown in Fig. 1, there being one crane per long berth (for 600-ft. ships), now occupied by two of the short berths for ocean-going ships. When it came to be recognized,

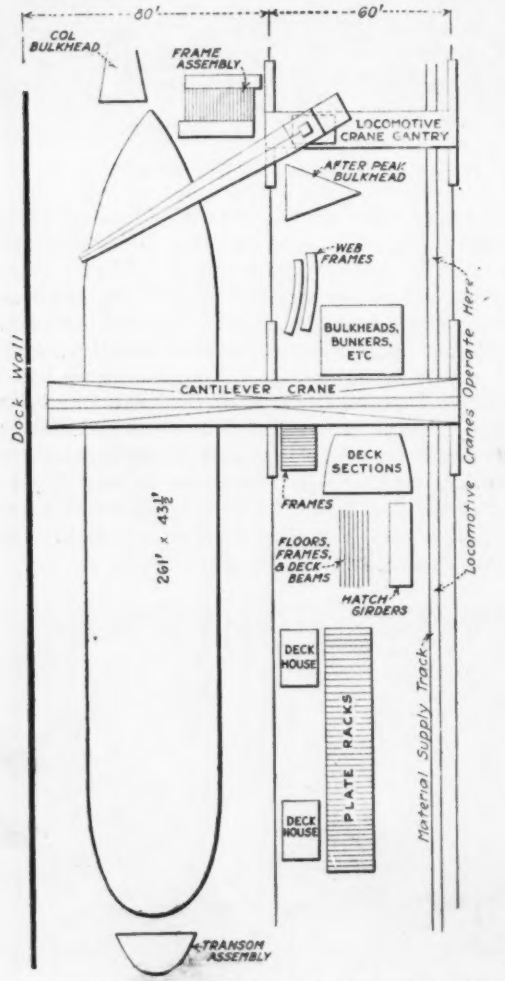


FIG. 3. FABRICATED MATERIAL STORED AND ASSEMBLED IN BAY BETWEEN CRANE TRACKS

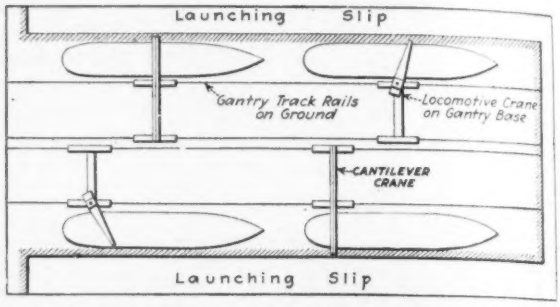


FIG. 4. REVERSED PLACING OF LOCOMOTIVE CRANES ENABLES BOOMS TO REACH ENDS OF PIER

early in the present year, that the crane capacity was inadequate for taking care of the maximum rate of supply of material or for handling it fast enough for the most rapid work on the shipbuilding berths, a second crane was ordered for each runway. The cantilevers had proved entirely satisfactory in their 12 years of service, but for the new machines locomotive cranes mounted on gantry substructures were selected because this was the only type that could be delivered within a reasonable time. The substructures were built by the Russell Wheel & Foundry Co., Detroit; Orton & Steinbrenner locomotive cranes with 75-ft. booms were mounted upon them, at the end facing the berth. The boom can reach over the entire width of the building berth and also over the space covered by the gantry. Covering a wide area by slewing, the crane has distinct advantages for pre-assembling, the management states.

Both the cantilevers and the locomotive cranes have a lifting capacity of seven tons (the cantilevers at 40-ft. reach, the locomotive cranes at 50-ft. reach). The hoisting speed is 80 to 90 ft. per minute, and the travel speed 250 ft. per minute.

The gantry track rails are carried on stringers at the ground level, and do not interfere with the free handling of material. A pair of trolley wires about 8 ft. above the rear rail furnishes 250-volt direct current to a pair of contact-trolley wheels attached to the gantry leg.

At present the output of the Ecorse yard, with eight berths, is two ships per month. This means about four months' normal building time per boat, from keel-laying to launching. What fixes the rate of output of the yard is the general balance of yard facilities, all of which are adjusted to the present production of 20 to 24 ships per year. Expansion of the yard in its various departments has been in progress continuously for the past two years. Further expansion is now going on, chiefly in great enlargement of the fitting-out dock and warehouses and in improvement of the general facilities of the yard.

In common with all lake shipyards, the Ecorse plant was designed primarily for building the larger lake ships, in which each unit has three to four times the tonnage of steel required in the small ocean-going

ships now under construction. On the other hand, the propelling machinery, cabins and other equipment items are little more for the large ship than for the small one. When the yard facilities are applied wholly to the present type of small ship, therefore, and the number of ships corresponding to a given yearly output of fabricated steel is greatly increased, excessive demands are placed on the engine and boiler shops and on all departments of the yard outside of those connected with hull construction. This is the reason underlying the expansion of shop and other facilities at Ecorse as well as at all the other lake yards.

The work on the ocean-going ships being of a new kind, the attainable rate of speed in construction was a matter for gradual development. The record work on the "Crawl Keys" resulted in the attempt to show how far the possibilities of ship erection could be carried.

Ship Built in Fourteen Working Days

Conditions at the Ecorse yard early in July made the attempt at a speed record in shipbuilding appear timely. The plans for such an attempt had been laid some time before. Though the Lakes had been the most active ship producers in the United States for months past, the shipbuilders of the district felt that their work had not received the same recognition as the records in rapid erection made on the Pacific Coast and on the Delaware. Ecorse was two ships ahead of its schedule; a temporary steel shortage had developed, and, while the berth schedule might be disarranged for a time, the total production for the year would not be cut down by centering all effort on one ship. One pair of berths, served by two cranes, was in such condition that both cranes could be concentrated upon one of them.

On July 11 the keel of the "Crawl Keys" was laid. Pre-assembled parts were already largely completed, and the problem in hand was simply that of quickest possible erection. Figs. 5 and 6 show the ship on the second and fifth days. The progress during the first week, while the main structure of the ship was going up, is summarized in the following notes:

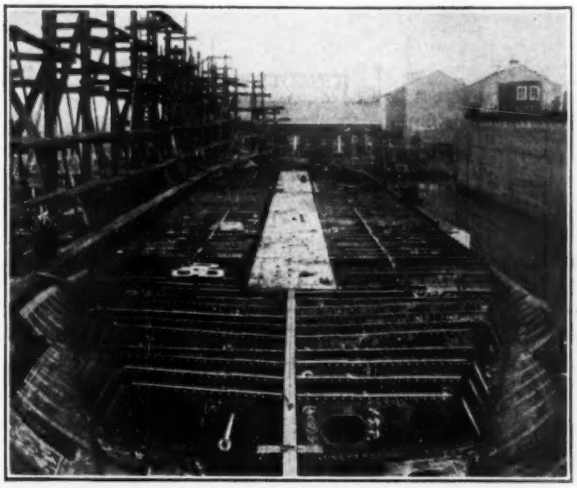
July 11, vertical keel, all floors and the rider plate placed, and transom assembly started adjacent to the stern. July 12, water-side scaffolding erected, stem and stern posts set, margin plate, collision bulkhead, and lowest strake of the side plating bolted up. July 13, part of tank top plating and after-peak bulkhead set. July 15, bunkers and breeching, frames aft, and transoms erected. July 16, engine-room bulkhead, midship and bow frames and sheer strake placed, and tank top completed. July 17, most of deck beams and hatch coamings erected, and shell plating and deck completed, including the pre-assembled poop deck.

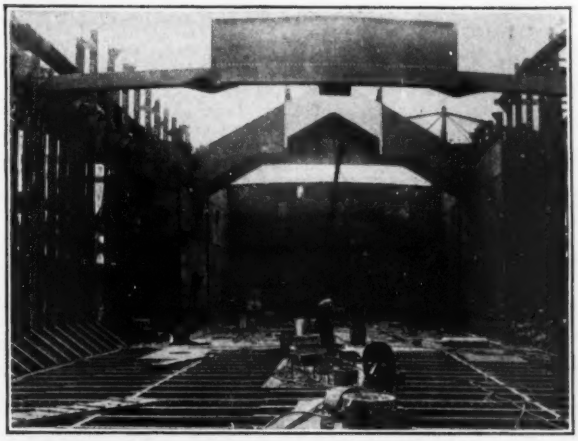
July 11	127 tons	day gang only
July 12	160 tons	dag and night gangs
July 13	56 tons	day and night gangs
July 15	51 tons	day gang only
July 16	140 tons	day and night gangs
July 17	81 tons	day and night gangs
July 18	100 tons	day and night gangs
July 19	117 tons	day and night gangs
July 20	85 tons	day and night gangs
July 22	25 tons	day gang only
July 23	58 tons	day and night gangs
July 24	16 tons	day and night gangs
July 25	5 tons	day and night gangs
July 26	32 tons	day and night gangs
July 27	19 tons	day and night gangs

The tonnage of steel erected during the work is shown by the tabulation in the preceding column.

On July 27 the vessel was launched. By that time 200,000 of the 270,000 rivets in the ship had been driven. This means that 100,000 rivets were driven per week, or 17,000 per day, on the average.

Night shifts were worked regularly, but the night force at no time exceeded half the day force. The greatest number of men at work on the ship while on the stocks was 493, the day before the launching. During the entire building period the day force averaged 320 and the night force 135. Up to 26 riveting gangs worked on the day shift, and seven on the night shift. Though two cranes were available, most of the work was done with the cantilever, as the locomotive crane broke down soon after starting.





FIGS. 5 AND 6. THE "CRAWL KEYS" DURING THE SECOND AND FIFTH DAYS OF ERECTION

Fig. 5—Material placed by one crane in day and a half. Fig. 6—Coal bunkers and bulkhead are five erection units

Fitting out proceeded at the same high-pressure rate as the work on the building-berth. Two days after the launching the boilers were set in the ship (Fig. 7); only 33 days after the keel laying the ship was completed and accepted, and the next day it steamed away in charge of a United States Shipping Board crew.

Two features of the punch shop contribute to over-all efficiency: Usually large raw-steel storage, and frame joggling or offsetting as a substitute for using liners under the plating. None of the other Lakes yards follow the practice of joggling, but at Ecorse it is regular practice. In the view, Fig. 8, the joggled floor flanges

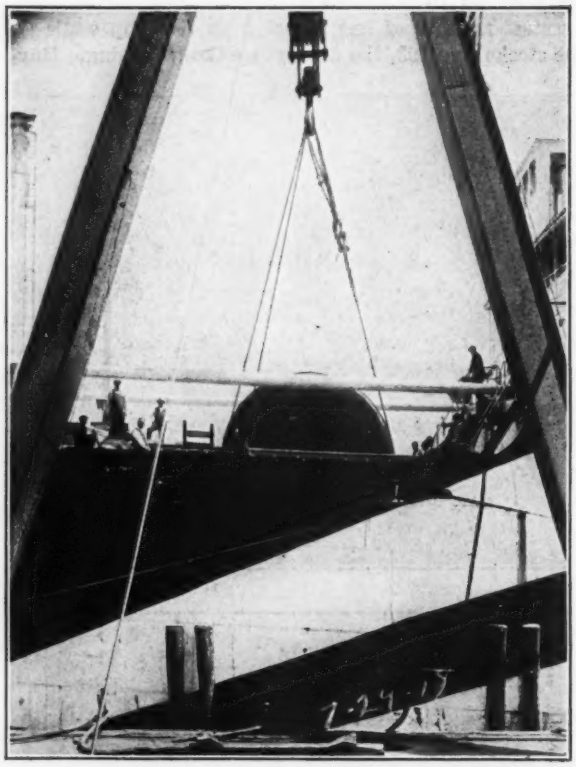


FIG. 7. SHEER LEGS DROPPING BOILER INTO SHIP EIGHTEEN DAYS AFTER KEEL WAS LAID

may be seen. A single joggling press in the punch shop is able to take care of all the work.

As the advantage of joggling lies partly in cost saving and partly in a reduction of weight of the vessel, resulting in increase of the cargo-carrying capacity (by 50 to 60 tons in the 3500-ton ship now building), it is worth notice that the Ecorse authorities report no delay or other interference due to joggling. Superintendent Baisley goes so far as to say, "a joggler is the best thing in a shipyard; we wouldn't be without it." A maximum performance of 3000 joggles in eight hours has been made by the machine, but a more usual high figure is 2600. This is on tank-top angles, which can be run through the machine by hand. Channel frames, requiring the use of chain falls while passing through the press, are slower. Three men are required at the machine, but the working costs are said to be well within 10c. per joggle. Liners under the shell plating would cost at present prices about 40c. for material and 10c. to 15c. for fitting and punching, or at least 50c. per liner, as against 10 to 15c., the cost of two joggles.

At the joints of the shell plating, tapered liners are used, as in other Lake yards; no scarfing is done. These liners are usually forged, but at Ecorse they are shaped by rolling in a small pair of eccentric rolls.

Back of the punch shop an area about 150 x 500 ft. is devoted to raw-steel storage. It is spanned by a gantry bridge, traveling parallel with the punch shop. This space is used largely for storage of plates in racks, or material intended for immediate use in the shop. Back of this is an area of five to six acres, every foot of which is reached by locomotive crane, and this is used for general storage of plates and shapes.

The advantage of large storage area is supplemented by direct routing of material through the shop. Plates and shapes pass in a straight line from storage to the loading track at the front of the shop, and thence the fabricated material is transferred by car to any of the berths, going down the track under the ship-erection gantries to be unloaded at the point of use.

A force of 2000 on day shift and about 450 on night shift is the present complement of men at Ecorse. This force is not fully up to requirements, say the officials of the company, and 400 to 600 competent men could be used in addition. There is a limit to the number of inexperienced workers that can be absorbed in a given time, and as men are leaving continuously the work of increasing the force is slow.

No ship erection is done at night, except in special cases like that of the "Crawl Keys." The working time is 10 hours day (7-12, 12:30-5:30) and 12 hours night (6-12, 12:30-6:30).

For riveting 76 gangs are available, or an average of nearly 10 per hull. This means that the hulls which are in their maximum riveting condition have 25 to 30 gangs each, driving about 60,000 rivets per week in each hull. About 15 of the gangs are on night shift, doing usually only pre-assembly riveting. The stock of air tools includes about 120 riveting hammers, 50 to

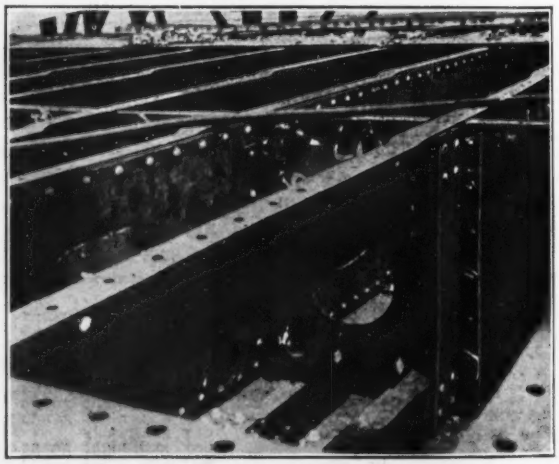


FIG. 8. JOGGLING USED TO REDUCE NUMBER OF LINERS

60 chipping and calking hammers, and about the same number of reamers.

Air is supplied by 4 two-stage vertical 3000-ft. compressors. Two horizontal machines of 2500 ft. capacity are being added, which will make the total capacity 17,000 cu.ft. of free air per minute—a supply ample for the service required at the present rate of output.

Of the new yard facilities now being built, two items of special note are of interest: A large cafeteria and a new fitting-out dock. The cafeteria, 60 x 270, will be able to feed a large part of the working force.

A timber bulkhead wall 1000 ft. long is being constructed along one side of the yard, forming the side of a wide dredged slip. On the dock will be a crane track of 20-ft. gage, founded on piles, to carry a locomotive crane tower. A 15-ton crane on this tower will handle all the fitting-out except placing boilers and engines. These two items will be cared for as heretofore by the yard shear-legs at the river front.

Waterproofed Floors for Railway Crossings Over Streets

Grade-Crossing Work Makes Severe Demands—Troughing Unsatisfactory—Concrete Slab Floor—Various Methods of Sealing Concrete to Girders

By H. T. Welty

Engineer of Structures, New York Central Railroad, New York

In recent years the waterproofing of the floors of railroad bridges carrying ballasted tracks has received considerable attention from engineers. This is partly due to the increasing numbers of grade-crossing-elimination and track-elevation projects, in which it is necessary to make railroad bridges over city streets as nearly water-tight as possible, and partly to the desirability of protecting from corrosion the steel in the floors, especially in bridges subject to the effect of brine from refrigerator cars.

Prior to about 1905, practically all of the floors of ballasted bridges with which the writer has had experience were of the trough type. The bottoms of the troughs were covered with what was known as "binder," composed of ¼-in. gravel or sand mixed with asphalt paving composition or coal-tar pitch, in the proportion of 1 cu.ft. of the former to 1½ gal. of the latter. The binder was sloped up on the sides of the troughs, and down along the bottoms of the troughs to drainage nipples. The ties were placed in the troughs on ballast, the base of the rail generally being 1½ in. to 2 in. above the top of the upper trough cover plates, or sufficient to clear the rivet heads. The troughs were generally about 16 in. wide.

Trough Floor Found Objectionable

This type of floor was very objectionable, because of difficulty in tamping the ties, and in cleaning and painting the insides of the troughs above the binder, and because the floors generally leaked, although the binder generally gave excellent protection to the steel.

About 1906 it was decided to substitute a membrane waterproofing sheet for the binder, as shown in Fig. 1. The trough type of floor was retained, although the design was varied occasionally. So-called saturated burlap was first used for the membrane, this being afterward combined with felt; it was finally discarded in later designs for a membrane consisting entirely of saturated felt, due to the fact that it is practically impossible to saturate burlap, with the result that any moisture which gets to the burlap is drawn into its strands and ultimately rots them. This design was more effective in waterproofing the floors, but was not entirely satisfactory in this respect. Leaks of greater or less magnitude occurred at various points, these being especially noticeable along the webs of the girders.

The other objectionable features of a trough design remained. In fact, a trough floor can hardly be defended except where a very shallow floor depth is necessary.

The desirability of obtaining a smooth surface upon which to lay the waterproofing and the ballasted track led to the use of a floor consisting of transverse I-beams spaced 15 or 16 in. apart and riveted to the girders, with a continuous $\frac{7}{16}$-in. plate deck riveted to the top flanges as shown in Fig. 2, or with a reinforced-concrete deck about 4 in. thick where sufficient floor depth was obtainable, as shown in Fig. 3.

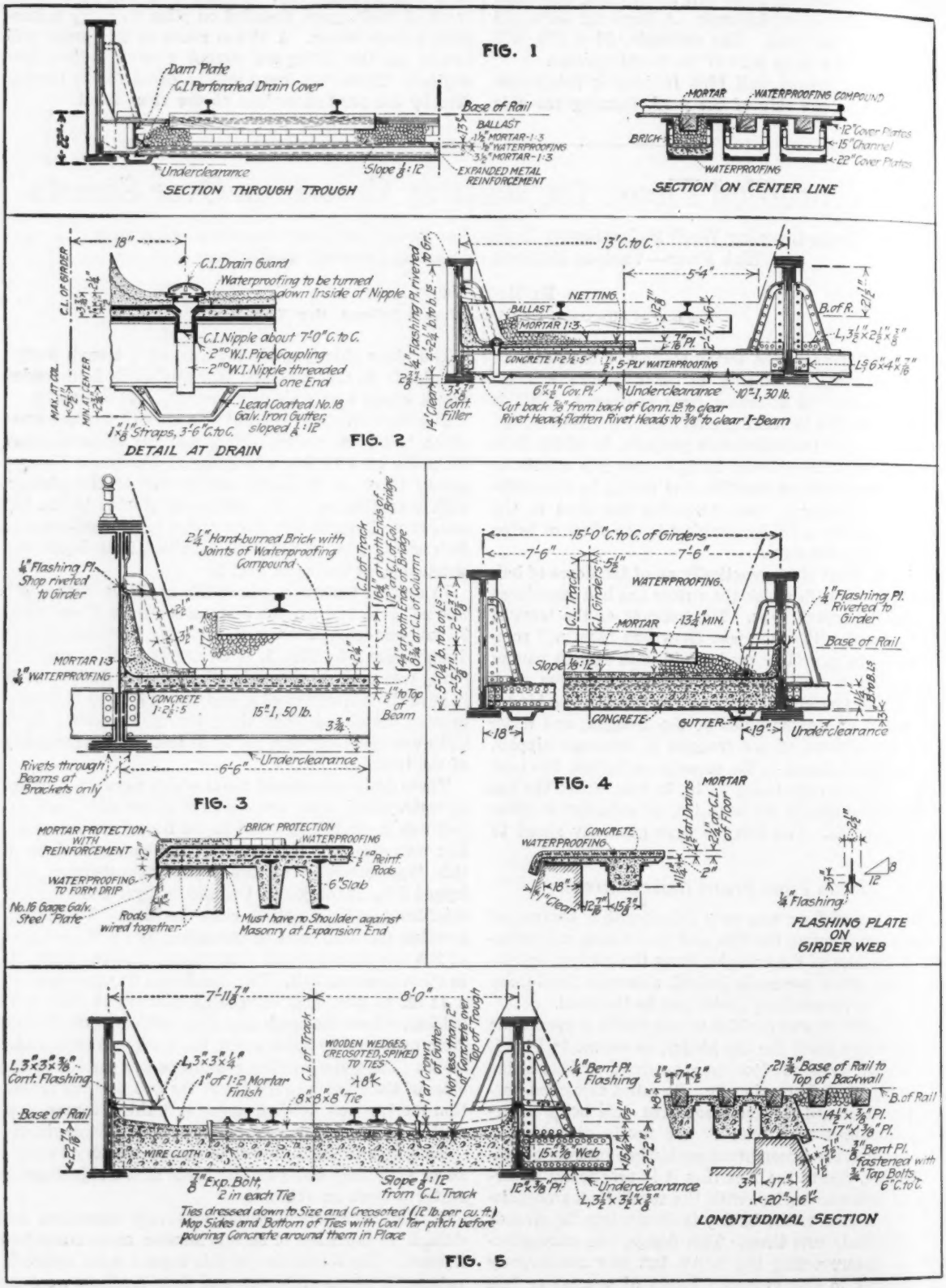
In several instances, where the available floor depth was not sufficient for the designs shown in Figs. 2 and 3, but was greater than that of the ballasted trough design shown in Fig. 1, a trough floor with concrete filling was used, as shown in Fig. 4. This design, while it gave the advantage of a smooth surface to be waterproofed, developed leaks along the girder webs. Such leaks were probably due, partly at least, to the flexibility of the troughs.

These designs produced floors which were much easier to waterproof, were more nearly water-tight, and effectively protected the steel in the floor from corrosion. The waterproofing membrane of the earlier designs of this type consisted of five layers of saturated felt, lapped 2 in. at the joints, the middle layer being usually reinforced with a cotton cloth backing. The waterproofing material used in cementing the various layers of felt was in some cases straight-run coal-tar pitch and in other cases asphalt. The membrane was protected by a 1½-in. to 2-in. slab of mortar, reinforced with wire netting, where the work was done without interference from traffic, or by brick where the work was done under traffic. The waterproofing membrane was carried up the sides of the girders to the top of the rail, and the protection mortar was finished under a flashing course, consisting of bent plates riveted to the webs of the girders.

This type of floor proved fairly satisfactory but was never absolutely water-tight. Some of the objectionable features were as follows:

1. The bent-plate flashing was very expensive and difficult to fabricate in such a manner as to make neat finishes. The difficulties in this regard were especially noticeable where stiffeners and floor brackets were encountered.

2. Deflection of the floor under load has a tendency



EARLY TYPES OF WATERPROOFED SOLID FLOOR FOR RAILWAY BRIDGES OVER STREETS

Fig. 1. Trough floor with membrane waterproofing. Fig. 2. Steel-plate floor. Fig. 3. Reinforced-concrete slab floor. Fig. 4. Trough flooring filled with concrete. Fig. 5. Ties embedded in concrete floor-filling

to separate slightly the concrete and waterproofing from the girders, permitting water to work down the webs of the girders and causing unsightly discoloration on the bottom flanges. Such points seemed generally to be the most pronounced sources of leaks.

3. Where the structure consisted of two or more spans, such as a crossing over a street with columns on the center line of the street or on the curb lines, reverse bending over the supports invariably opened up joints and produced leaks over the columns.

Another type of floor similar in character to the above, and quite extensively used where the spans were not too long, consisted of beams placed longitudinally instead of transversely, thus eliminating the necessity for side girders. As a rule, such a floor is more nearly water-tight than the one with transverse beams and longitudinal girders. In fact, there seems to be no reason why such a floor should not be absolutely water-tight, if proper materials are used for waterproofing, if these materials are properly placed, and if the drainage slope to the nipples is sufficient to carry off the water.

Good Track Obtained Without Ballast

In some cases, where the floor depth obtainable has been too small to permit the use of a floor with a smooth surface, and troughs have been necessary, the expedient of filling the troughs with concrete, embedding the ties in the concrete, thus eliminating ballast, has been used. This design is illustrated in Fig. 5. The ties were creosoted and securely bolted to the concrete filling. No waterproofing, other than filling around the ties with asphalt or pitch, was used. It was thought that the water would flow off the surface of the concrete to the drains with sufficient rapidity to prevent leakage. This proved to be the case, generally, in single-track bridges where it was possible to get good drainage slopes; but in double-track bridges, where the surface of the concrete between tracks was necessarily nearly level, the water did not flow away rapidly and many leaks appeared, the water finding its way down through small cracks in the concrete. This design has been criticized on the ground that tie renewals would be difficult. With creosoted ties, however, renewals should be infrequent and it is thought that the work can be done without great difficulty. Bridges with such floors have been in service for about seven years, and seem to be satisfactory so far as the track is concerned.

Concrete Carried to Top Flange of Girders

The high cost of bent-plate flashing along the webs of the main girders, and the unsatisfactory results obtained with this detail, led to the type of floor shown in Fig. 6. The floor brackets were kept small, and the concrete base upon which the waterproofing was to be laid was carried up to the underside of the top flange of the girders, entirely incasing the brackets and stiffeners, thus providing a perfectly smooth trough the full length of the bridge; this simplified greatly the work of applying the waterproofing. The concrete base along the sides of the girders was reinforced with rods run through holes punched in the girder stiffeners and the floor brackets, and the mortar protection over the waterproofing was carried up flush with the outside edges of the girder top flanges, leaving the top of the flanges exposed.

In one bridge of this type, consisting of five tracks with girders between the tracks, one track was waterproofed with five-ply saturated felt and coal-tar pitch, three tracks with five-ply saturated felt and asphalt, and one track with two-ply saturated cotton drilling and asphalt. Few leaks have been discovered in this bridge, and these are of rather minor importance. After the concrete had set it was found to have shrunk slightly away from the girder flanges, leaving a very small opening into which water finds its way during driving rainstorms and ultimately works down along the girder webs at points where the waterproofing membrane was not carried up tight against the girder flanges. The floor on which the cotton drilling was used showed practically no leaks. This is attributed to the fact that drilling is very pliable and can be thoroughly worked into corners without danger of tearing, thus making a perfectly tight job possible.

Experience With Concrete Extended Over Girders

To overcome the possibility of leakage under the top flange of the girder, the type shown in Fig. 7 was tried. This design is practically the same as that shown in Fig. 6, with the addition of a waterproofing sheet over the top flange, carried down and flashed over the main waterproofing course terminating under the flange. The concrete protection over the girder flange was made about 6 in. thick and was reinforced to prevent cracking.

The first bridge of this type consisted of two spans, which introduced the problem of caring for the reverse bending over the columns. To prevent cracking of the concrete and a possible tearing of the waterproofing over these supports, some flexibility had to be provided. At the same time, it was desired to keep the waterproofing sheet continuous. The concrete base was separated along a plane passing through the center lines of the columns and the abutting ends of the girders, by means of a tar-paper joint. The waterproofing membrane was then given a fold immediately over this joint, which provided a little flexibility. A joint was also provided in the protection mortar over the joint in the concrete base, and this joint was filled with expansion-joint cement. The waterproofing sheet on this bridge consisted of two layers of saturated cotton drilling and asphalt waterproofing compound.

An inspection of the bridge after it had been in service about one year showed no signs of leakage whatever, either along the girders or over the columns, and it is believed that a water-tight bridge has been secured.

The construction shown in Fig. 7, besides giving very efficient waterproofing results, also protects the top flanges of the girders which usually require considerable painting maintenance. The concrete coping formed by the girder capping gives a pleasing appearance to the bridge as seen from the side.

Where the span is long and the girders are deep, it would be rather expensive to adopt this design, because of the excessive weight of the concrete base along the girders. It is thought that in such cases fairly satisfactory results could be obtained by turning the water

proofing membrane into a groove along the webs of the girders, then filling the groove with expansion-joint cement and grooving the top of the protection mortar, filling this groove also with the cement, as shown in Fig. 8. The grooves would be somewhat above the elevation of the top of the rail.

There are, of course, many other types of waterproofed floors of railroad bridges, some of which are simply modifications of those mentioned, and others designed to meet some special condition. One of the latter, designed to meet a shallow-floor-depth requirement without the use of the old trough type, is shown in Fig. 9. This floor, while fairly satisfactory, proved defective so far as waterproofing was concerned. During the first winter in which the bridge was in service the ballast froze solid. When the ballast started to thaw in the spring, water forced its way through shrinkage cracks between the protection concrete and the flanges of the channels forming the top cover plates of the floor-beams and diaphragms, and thus down back of the waterproofing.

Success Depends on Several Factors

In the writer's opinion, the success of a waterproofed bridge floor depends upon the design, the workmanship in laying the waterproofing sheet, and the materials used, the relative importance of each being in the order given. If the design is defective, the result will probably be unsatisfactory, no matter how excellent the workmanship and materials may be. On the other hand, a good design may be spoiled by poor workmanship in applying the waterproofing. With a good design and good workmanship, probably any of the better kinds of waterproofing materials will be satisfactory, although some have inherent qualities, not possessed by others, which tend to produce the results desired.

Based on experience with various types of waterproofed bridge floors and on various kinds of materials, it is the writer's opinion that observance of the following points will be conducive to good results:

Suggestions for Design

Floors should be made as deep as possible, so as to avoid excessive deflection.

Pockets and projections in the surface to be waterproofed, such as are presented by a trough floor, or by floor brackets, stiffeners, etc., should be avoided. In other words, the surface to be waterproofed should be as smooth as possible.

Joints between concrete and steel, such as are formed by finishing the mortar protection against the webs of girders or under the top flanges, should be avoided. The concrete or mortar always shrinks slightly in setting, forming small openings at such joints through which the water finds its way. If such joints are necessary, grooves should be formed and filled with an elastic expansion-joint cement such as is used in sealing joints in vault lights.

The slope of the waterproofed surface should be made sufficient to drain off the water rapidly. A nearly level surface, or one in which pockets have been formed, will hold water which will ultimately find its way through the waterproofing, unless the waterproofing has been perfectly applied. If the span is short and the floor depth sufficient, the water may be drained directly over the backwalls. If this is impracticable, scuppers along each side, draining into gutters and downspouts, will be necessary. Scuppers and drainage nipples should be made of ample size to prevent freezing and thus sealing the openings. Downspouts should be provided with clean-out plugs.

Care should be taken to prevent the seepage of water between the tops of backwalls and the under side of the floor resting on the backwalls. This is generally done by flashing the floor down well below the top of the backwall, and this is generally sufficient if the fill behind the abutments is of porous material. Another design which has been used consists of a line of tile drainpipe back of each abutment at about subgrade elevation, draining into a catchbasin located between tracks and made accessible through a manhole. The catchbasin is drained in the most convenient manner to a sewer, if one is available.

At points of reverse bending, such as those over columns of bridges over streets, a flexible joint should be provided, if possible. In skew bridges this is likely to be difficult, but if it is not done leaks of greater or less size are almost sure to occur.

Important Precautions as to Workmanship

The finished surfaces of the concrete and mortar should be as smooth as possible, with a uniform slope to drains. The concrete should also be made dense.

In heating the waterproofing compound, care should be taken to avoid overheating. This is especially to be observed in the use of coal-tar pitch, which has a high percentage of volatile constituents. Coal-tar pitch which has been very much overheated becomes brittle like glass when cold, and in this condition is worthless as a waterproofing material.

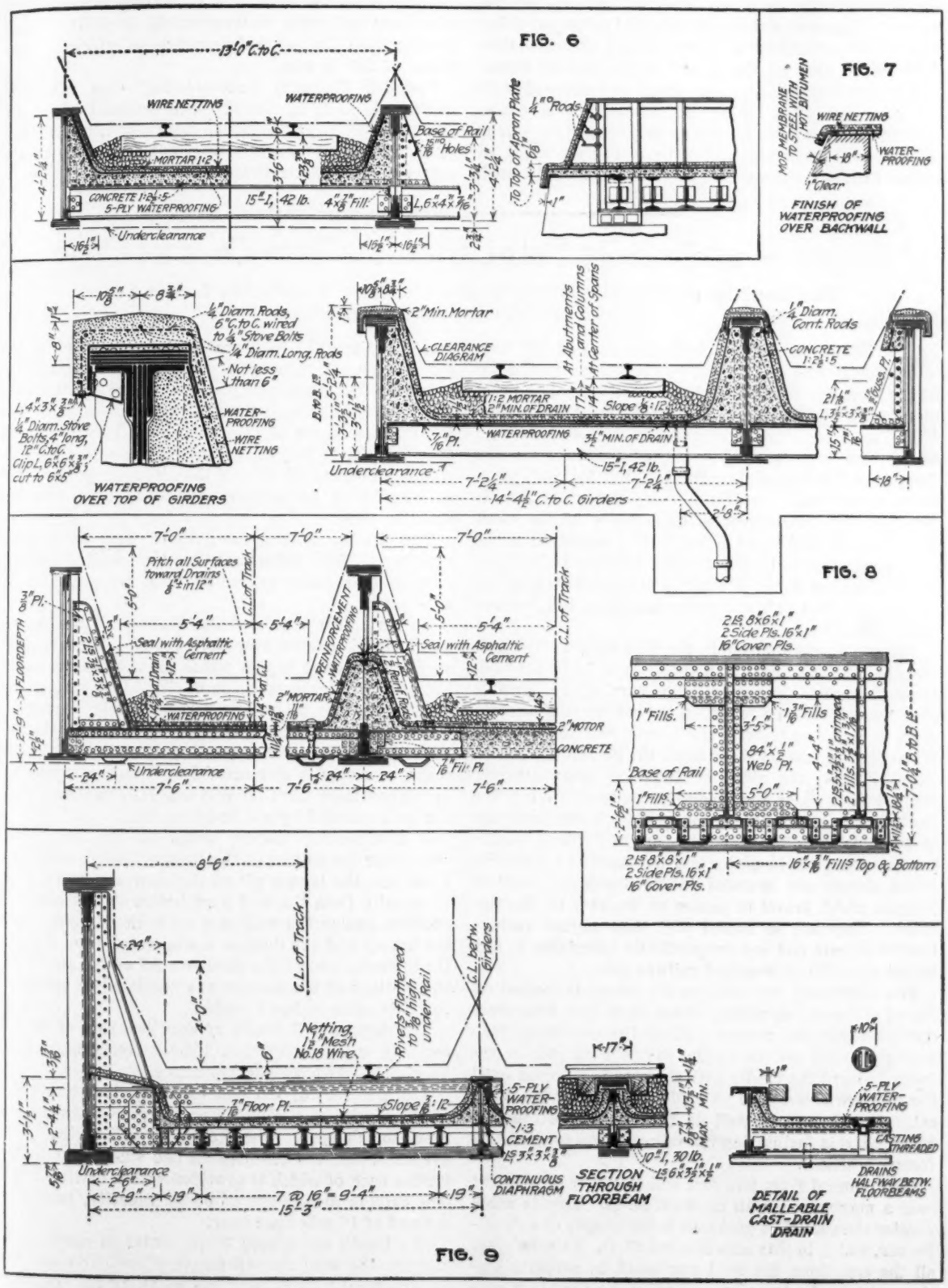
The membrane sheets should be laid perfectly smooth, with all wrinkles pulled out, and should fit snugly into all corners. They should be laid in hot compound, so as to secure a thoroughly cemented blanket. Sufficient compound should be used to cover entirely the surface upon which the membrane is to be laid. Unless the swabbing is carefully done, the surface will be porous, or full of spots not covered by the compound. This is especially true where the compound is applied directly to a concrete surface.

The sheets of membrane should be lapped at least 2 in. at joints, with joints thoroughly cemented, and with the sheets flashing in the direction of the natural flow of the water.

The Waterproofing Materials

The compound should be not only impervious to water, but also unaffected by water, mild acids and brine. It should remain elastic at as low a temperature as possible, and at the same time not flow at a moderately high temperature, such as would result from the direct rays of the sun. It should be perfectly stable, so that deterioration will not occur with age.

The membrane should be one which can be thoroughly saturated, has considerable tensile strength, and is tough and flexible. In the writer's opinion, cotton drilling fills all requirements for a good waterproofing



FOUR RECENT DESIGNS OF SOLID FLOOR USED IN GRADE-CROSSING ELIMINATIONS

Fig. 6. Floor concrete carried up to girder flange. Fig. 7. Waterproofing and concrete extended over top of girders. Fig. 8. Concrete protection kept below top flange and sealed to web. Fig. 9. Special design for a shallow floor

membrane better than any material yet put on the market. This material may be obtained saturated either with asphalt or coal-tar pitch. It is more expensive than felt, but in view of the fact that the cost of waterproofing is usually relatively small as compared with the total cost of a bridge, the excess cost of cotton drilling is warranted by its superior qualities. Good results have been obtained with a two-ply sheet of cotton drilling, whereas five-ply felt is generally used. On this basis the total cost of waterproofing with a membrane of cotton drilling should be little, if any, greater than that of waterproofing in which a membrane of felt is used.

So-called "integral waterproofing" has not been mentioned, as it is thought such material would not be very effective in connection with a structure subject to considerable vibration and possible cracking of the concrete, such as a railroad bridge.

Dumper at Sewalls Point Handles Two Cars at Once

New Facilities of Virginian Railway at Coal Pier Near Norfolk Also Include Cars of 120 Tons Capacity, and a Long Incline

A DOUBLE car dumper, with pier cars of 120 tons capacity and an elevator to raise them to the top of the pier, has been added to the facilities of the coal pier of the Virginian Ry. at Sewalls Point, near Norfolk, Va. They supplement a single dumper, pier cars of 60 tons capacity and a barney incline from the dumper to the top of the pier, installed in 1909, when the pier was built (see *Engineering Record* of Feb. 5, 1910, p. 148) and increase the capacity of the plant from 1500 to 3000 tons per hour. The operation of the pier is the same as before, the pier cars for both dumpers running out to the end of the pier by electric power on the outside track and returning down the inclined center track.

The double car dumper is the first built to overturn two ordinary road cars at a time. It is 94 ft. long between end posts. The car rails are carried on a movable platen which rests on rollers in the bottom of the cradle —or, in fact, two platens, end to end, one for each car. When the cars are on the dumper the platens are moved laterally until the sides of the cars come securely against the side of the cradle for support. When the two cars are of about the same width it is not necessary to uncouple them, but when they are of different widths the two parts of the platen can be operated separately. Eight clamps are operated independently by counterweights which travel in guides at the rear of the machine. They are so spaced that they engage various lengths of cars and are automatically adjustable to any height or width of standard railway car.

The machinery for rotating the cradle is located on top of the main structure, where it is free from dust and accessible for repairs. After the cars have been properly placed on the cradle, the rotating mechanism is started and the cradle with the cars is revolved until the cars are inverted to an angle of 20° with the vertical. The clamps as well as the cradle are counterweighted, this facilitating the return of the cradle to its former position.

Coal dumped from two cars end to end is distributed over a maximum length of about 88 ft. This is much greater than could be gathered in the hopper of a transfer car, which in this case is about 51 ft. In order that all the coal from the road cars shall be properly discharged into the transfer cars without resort to a concentrating chute, which would at once result in an extreme drop of the coal, two steel apron conveyors are provided, each about 8 ft. wide and 34 ft. long, supported horizontally in a portal frame in front of the car dumper. A clear space of about 36 ft. is left between the conveyors, which form a portion of the bottom of a hopper into which the road cars are dumped. The longitudinal center of the conveyor is located directly over the center line of the transfer-car track. With this arrangement all the coal that falls on the conveyors is transferred horizontally and discharged into the transfer cars.

Two 275-hp. motors, designed to work on a direct current of 550 volts, operate the cradle, working through four drums geared by three reductions of cut spur gears.

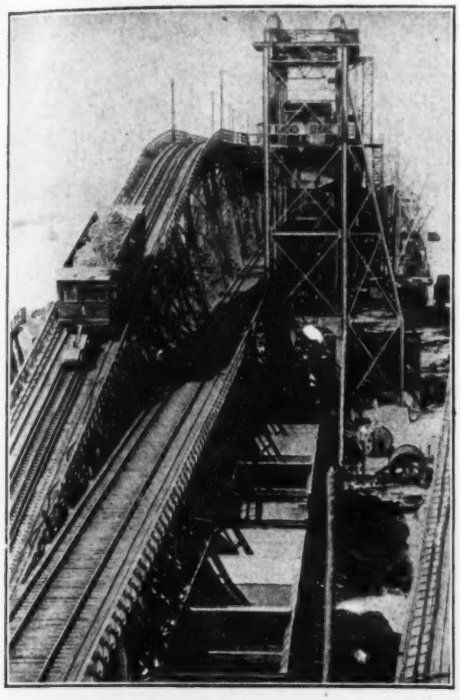
As the cradle is rotated the contents of the car are gradually discharged over the edge of the apron plate, into the receiving hopper which carries the conveyors. This hopper, for a distance of 36 ft., is open at the bottom, and the coal is discharged directly through it into the transfer cars. The conveyors are interlocked with the cradle, so that when the rotation starts the conveyor motor is also started, and the conveyors are in full operation when the first coal falls on them. They are both operated by one 80-hp. motor.

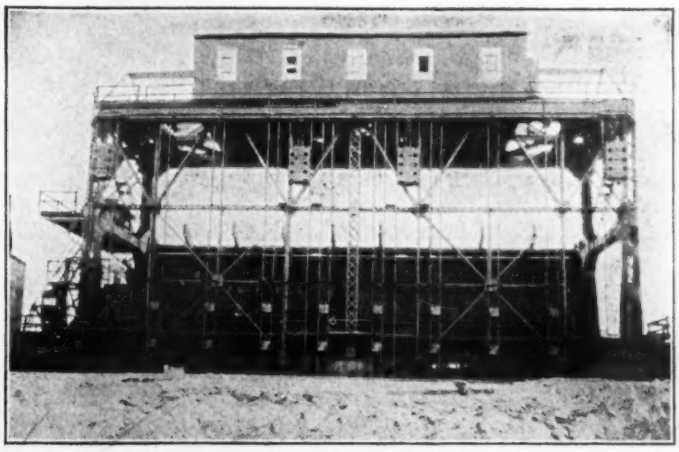
A disappearing barney, which on the return trip, when near the bottom of the incline, follows a low-level track into the barney pit so that cars can be let down by gravity from the load yard before the barney is in position, pushes the road cars up to the dumper. Both the barney and the dumper are operated from a cab at the incoming end of the dumper. All of the speeds and the motions of the dumper are regulated to produce a complete cycle in two minutes.

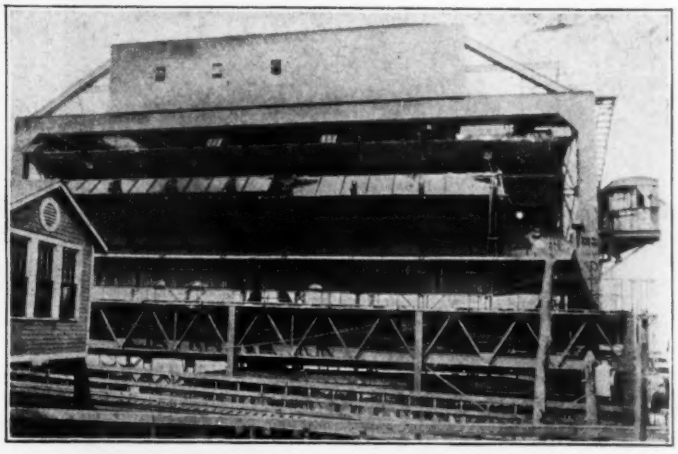
The dumper will handle at once two cars of 60 tons capacity, or one of the new 110-ton hopper cars of the Virginian, which weighs 160 tons when loaded.

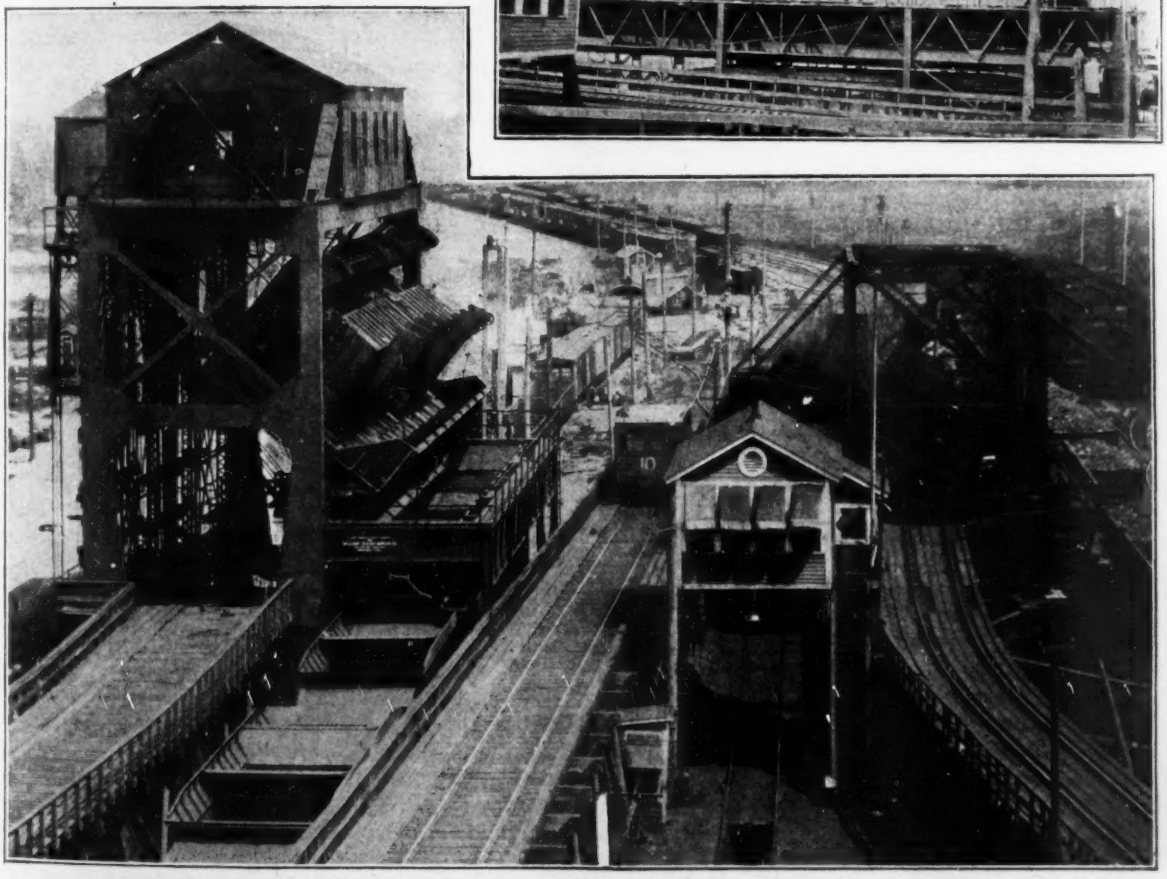
Transfer cars of 120 tons capacity—just double that of those originally installed on the pier—take the coal from the dumper. These cars, as one of the photographs shows, are mounted on two six-wheel equalized trucks, each of which is provided with a driving motor. The driving motors are of 60-hp. capacity, geared for a speed of 12 miles per hour.

The trucks are spaced 50 ft. center to center under the car, the total over-all length of which is about 70 ft., the height 16 ft., and the width 12 ft. The body of the car forms a hopper divided into three compartments, each having a capacity of 40 tons, the three compartments having a combined length at the top of about









TWO GENERAL VIEWS SHOWING OLD AND NEW FACILITIES SIDE BY SIDE, AND TWO OF NEW DUMPER HANDLING TWO ORDINARY ROAD CARS AT ONCE

51 ft. Each of the compartments is provided with a double system of discharge gates at the bottom, through which the coal passes into the pockets to the pier. The gates of each compartment are separately operated by an air cylinder located in the end of the car.

The discharge gates of each compartment are arranged in pairs and hinged to the car body at the sides and in the center, in such a manner as to provide two openings 9 ft. long by 3 ft. 8 in. wide. The operating mechanism is so arranged that the gates are securely locked when closed, and they cannot fall open.

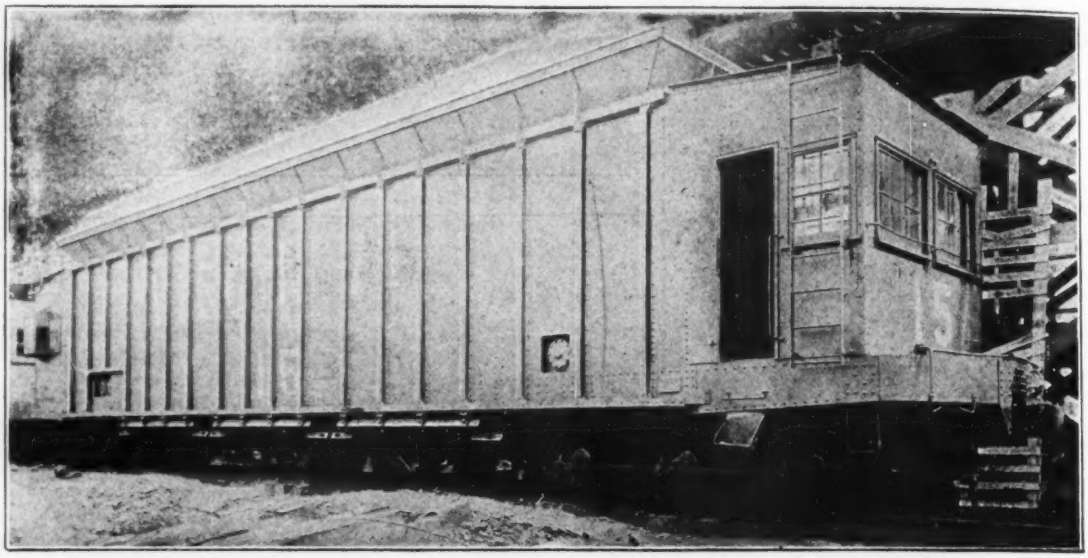
All operations are controlled from one end, although each end is inclosed. The power for operating the cars is supplied from an overhead catenary system. The combined weight of the car and its contents is about 200 tons, making the cars the largest coal transfer cars ever built.

The transfer car elevator raises the pier cars about 67 ft. to the top of the pier. Heavy counterweights are used to counterbalance the weight of the platform and the car; they are so regulated that as much power is required to pull down the empty platform as is required to lift the platform and the loaded car. This arrangement permits the use of smaller motors than would otherwise be necessary.

The elevator is operated by two 450-hp. motors using a direct current at 550 volts. The gearing of the elevator is proportioned to produce a complete cycle in two minutes.

Connecting the frame of the elevator to the pier is a hinged run-off girder, introduced to insure perfect alignment of the rails on the platform and the pier. This girder is hinged to the pier in such a manner as to permit of a vertical movement of the free end amounting to about 2 ft. The free end of the girder rests on brackets on the elevator frame, from which it is lifted by projecting lugs on the platform as it comes to the position of its upper limit. This upper limit of travel is accurately controlled by an electric limit switch, geared to the hoisting mechanism. The power is supplied to the trolley wires in this position, and the transfer car passes out of the elevator, over the hinged run-off girder and out on the pier, where the coal is discharged to the proper pocket. The empty car then returns down the inclined track in the center of the pier structure to the loading track in front of the car dumper, taking its regular turn.

These additions to the equipment of the terminal were installed by the Wellman-Seaver-Morgan Co., Cleveland, which company furnished the original dumper. The work was carried out under the direction of H. Fernstrom, chief engineer of the Virginian Railway.



ONE OF THE LARGEST COAL TRANSFER CARS EVER BUILT—CAPACITY 120 TONS

Corrects Article on Concrete Block Mattresses

B. Okazaki, author of the article on concrete-block river mattresses in *Engineering News-Record*, Oct. 17, p. 713, calls attention to a typographical error in the text at the top of the second column of p. 714. The sentences beginning at the bottom of the first column on this page should read "In the other types, part of the piles, the cribs or the fascines are very liable to be lost *in toto* from the severe scour or attacks of drift. In the examination of the costs only those works were examined that are constantly subject to severe attack of the current. The first cost and cost of maintenance and repair are considered since the year 1898. Optionally a term of 20 years was adopted as the standard from which to calculate the average of both the first cost and the cost of maintenance and repair per foot run of the river bank under protection." He states that the table showing comparison of costs and repairs of different types should have contained the designating letters A, B, C, D, E and F at the heads of the given columns in order, and that the following sentence should be added: "Works A and B are subject to the same condition of river attack; similarly for works C and D."

Shear in Concrete Ships Critical Point in Design

According to Accepted Theory, the Usual Thin Shell Monolithic with Frame Gives Rise to Dangerous Conditions

By A. C. Janni

Consulting Engineer, Park Row Building, New York City

CONCRETE ships as ordinarily designed have a shell 3 to 5 in. thick, integrally connected, by the concrete and the steel, to the main frames. From the nature of the ship as a hollow beam, this shell must carry practically all of the shear in the structure. It is the purpose of this article to show that unless this integral shell has a prohibitive thickness and an equally prohibitive amount of reinforcement, it will be unable to carry the shearing stresses without cracking, and that danger lies in the fact that any crack so caused will extend progressively, through the grinding action due to subsequent shearing stresses of high frequency.

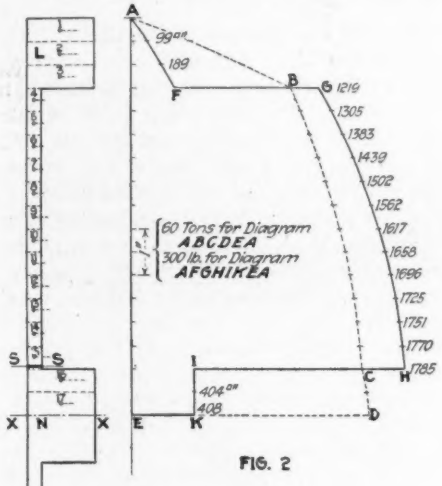


FIG. 2

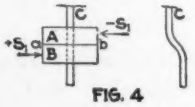


FIG. 4

FIG. 1

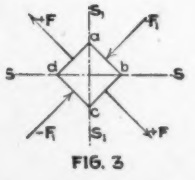


FIG. 3

Fig. 1 represents the theoretical cross-section of a side of a thin-shell 3800-ton concrete ship. This will carry one-half of the whole shear acting upon the ship at this section, which in this case amounts to 600 tons. The expansion L represents the cross-section of a longitudinal member at the top of the hull, the expansion M is that of another longitudinal member just above the bilge curve; the expansion N is a longitudinal shell beam referred to in a later part of the discussion. The dotted curve (Fig. 2) represents the distribution of total shear through the section, as determined by graphical analysis, and the solid curve represents the unit shearing stresses, obtained by dividing the total shear by the cross-sectional area of the true or developed sections, as the case may be.

For the purposes of this investigation the shears on these sections will be transformed to tensile stresses. For instance, consider the section SS which supports, very nearly, the maximum shearing stress (1785 lb. per square inch) and imagine that a cube *abcd*, Fig. 3, having a 1-in. side, be detached from the entire mass in that section. Since the side is 1 in. its diagonal will be 1.41 in., and the horizontal shear, acting along *db*, will be 2517 lb.; that acting along *ac*, of course, will be the same. These stresses may be combined so that they give place to a tensile stress $F = 2517 \times 1.41 \div 2 = 1785$ lb. and a compressive stress F, of the same amount, and acting as shown in the figure.

While the cube *abcd* is being stretched in one direction, it is being compressed in the perpendicular direction, by forces of the same amount. This condition is very trying on the material, and it must be taken into account in our investigation, if we wish to reach reliable results.

Assuming as ¼ the value of Poisson's ratio, and assuming the modulus of elasticity of the concrete to be 2,000,000, the shortening of the cube along the direction of F will be $1785 \div 2{,}000{,}000 = 0.00089$ in. Therefore, the corresponding stretching along the direction of F will be $0.00089 \div 4 = 0.000227$ in.; that is, this stretching would be caused by a force along F, and its value would be given by $2{,}000{,}000 \times 0.000227 = 445$ lb. This stress is to be added to F, therefore we may imagine now that the cube *abcd* is only under the action of a tensile stress of 2230 pounds.

How shall the steel be arranged to take its proportion of this tensile stress, which obviously is too great to be borne by the concrete? First assume that the steel be placed diagonally in two directions at 45° angles. With a unit steel stress of 12,000 lb. per square inch, and with the steel taking all the tension, the amount of steel per square inch will be $2230 \div 12{,}000 = 0.186$ sq.in.—that is, 18.6% of the concrete.

As the shear may invert its direction, the cube *abcd* may be stretched along F, and shortened along F, so we should add another 18.6% steel in the direction F.

But in dealing with concrete ships the assumption that the steel carries the whole tensile strength is not justified. In ordinary buildings this assumption is legitimate, for a crack in the concrete would actually throw the whole stress on the steel, but in ships we cannot have cracks in the hull, especially in the sides of it. If, therefore, we assume to have a crackless concrete, we must assume also that this concrete will deform exactly as the embedded steel does. For the 18.6% of steel and a ratio of $E_s \div E_c$ of 15, then, the tension in the concrete will be 619 lb. and in the steel 9285 lb. For a lower steel proportion the concrete tensile value will be higher and will undoubtedly cause cracks in the concrete. The problem, then, of the diagonal placing of the steel is to get so large a percentage of metal in so thin a shell of concrete.

Let us suppose now that we place the steel in two sets, one vertical and the other horizontal. If, Fig. 4, A and B are two adjacent elements of concrete upon which the internal forces *S-S* act as shown, then along *ab* we shall have shear. In order that the rod C may work it is necessary that the elements of concrete deform. In what consists the work of the rod C?

As the elements A and B and the rod C are not of the same material it is clear that during the shearing action the steel will tend to crush the concrete along the part of it pressing against the steel. As a result of this the rod C will be subjected to a certain amount of shear as well as to a double deflection deformation of very short radius, as shown in Fig. 4. Under shearing stresses, acting with a high frequency and continuously changing sign, the result will be the gradual releasing of the grip that the concrete has on the steel, and this will cause the concrete to carry more and more of shearing stress, until the limit is reached, when it will crack.

Incidentally, this explains the fact that in ordinary reinforced-concrete buildings some of the cracks due to the shear do not appear until after a certain period of time, notwithstanding the fact that during this period the construction has not been subjected to undue loading.

Horizontal Plus Diagonal Steel

If we should combine the horizontal and the diagonal steel in the sides of a hull we might expect a certain improvement in the static conditions of the material, but this improvement is not commensurate at all with the enormous amount of steel required, and does not solve the problem of covering efficiently all this steel by a relatively thin concrete shell.

We must consider that it is the thin shell of concrete which is supposed to bear the brunt of the shearing stress and, by its deforming, transmit it to the steel. This deformation of the concrete is not due to an even compression or tension in a determined direction, for the intensity of stresses as well as their directions change according to the distance between the neutral axis and the element we consider. If we take a cross-section under examination, we see that this, when subjected to shear, is no longer straight, but distorts so that it assumes the shape, familiar to all designers, which resembles an "S." Now, although the steel may somewhat attenuate this deformation, it cannot prevent it altogether, for the steel enters its rôle only through the deformation of the concrete.

An additional inconvenience in this kind of ship is the practical difficulty in the concreting of it. In order to avoid shrinkage cracks caused by the setting of the concrete, the skin of the sides of a hull should not be concreted in one continuous operation. Therefore we must expect construction joints. Dismissing as doubtful the idea that by a careful and painstaking concreting it is possible to obtain a satisfactory concrete bond between a set concrete surface and new concrete, it remains a fact that the hull, as far as shear is concerned, may be considered as already cracked, and as soon as the ship takes the sea the shear will set up a grinding action on the surfaces of the joints in contact, bringing about a progressive enlargement of them. Furthermore, if the joint is vertical the shear acting along this joint will act directly on the reinforcement, quickly destroying the adherence in this region between steel and concrete. During this grinding action the joint will also extend, in the shape of actual cracks, to the bottom of the hull and to the decks.

The type of hull with thick monolithic skin is not worthy of being discussed, because it can readily be seen that the thickness required in the sides of a ship to make it withstand the amount of shear would be quite unpractical.

We can now consider the type of hull, also with monolithic skin, but having inside longitudinal ribs, as well as vertical ones. In Fig. 1 we have shown a certain expansion N which is supposed to be the cross-section of a longitudinal rib. All considerations on this subject may be applied to cases in which more than one rib is used.

By inspection of diagram AFGHIKEA, it is seen that the addition of a horizontal rib brings about a purely local improvement—the improvement in the static conditions of the skin being quite immaterial—as can be deduced from the classical formula giving the shearing stress at any given point of the cross-section.

Therefore, excepting the very limited benefit (almost entirely local) accruing from the adoption of a horizontal rib, we still would have to deal with very important shearing stresses in the resulting panels of the shell. Furthermore, looking at the diagram, we observe that there are two very brusque variations in the value of the shearing stresses, and the question may be raised whether, after all, the adoption of longitudinal ribs does not render the joining sections between panels and ribs more liable to cracks—that is, making the hull more unsafe than before.

Vertical Ribs Do Not Relieve Shear

If we look again at the diagram we see that the adoption of vertical ribs does not affect in the least the action of shear upon the skin of the ship, except in the case, which hardly may be realized in practice, where the shear acts directly and solely on that vertical rib. For the other infinite number of shear applications, the vertical rib would not relieve the skin. Here also, as in the case of the horizontal rib, there is a possibility of cracking, due to the sudden change in the value of shearing stress at the joining section between the panel and the rib.

Finally, a type could be evolved having diagonals inside the shell. These diagonals may be divided into two sets, each of them inclined 45° to the horizontal, so that the sets are perpendicular to each other. If those diagonals were the only structural members between the top and bottom flanges, one set of them would work in compression while the other would work in tension, and the shear would disappear from the web. Unfortunately, conditions there are not such, for, in addition to the diagonals, there is the shell of the ship rigidly connected to the diagonals, and to the top and bottom members. The presence of this shell sets up shearing stresses in the web. It is true that in special conditions of equilibrium those diagonals may be a valuable help to the shell, but the conditions of

equilibrium of a ship cannot be controlled by the desire of the designer.

As a result of these studies, which are given only in brief, it is the conclusion of the author that the successful type of reinforced-concrete ship must be of such a design as to eliminate the shear through the skin of the hull.

It is further believed that a designer should have before him the following considerations: The working stresses in concrete should be so low that strain alternation does not fatigue the material; the working stresses of the steel must be determined as a ratio of those in the concrete, so that the materials may act together. The elastic system should be thought out in such a geometrical shape that shear, at least in all vital points of the system, is eliminated. The makeup of the hull should be such as practically to eliminate all causes of accidental cracks (shrinkage and the like), and the process of concreting should be directed in such a manner that it will accomplish this end.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Norwich the Oldest Civil Engineering Institution in the Country?

Sir—In your issue of Nov. 21, p. 955, Professor Winslow of Norwich University, Northfield, Vt., makes the claim that his institution is the oldest school of engineering in this country. Possibly the matter may be of enough interest for you to spare space for a quotation regarding this matter from the second edition of my "History of Rensselaer Polytechnic Institute":

"During the first quarter of the nineteenth century, however, three schools were established here, for each of which the distinction has been claimed of being the first school created in any English-speaking country for the purpose of teaching science. The earliest was established in Norwich, Vt., in 1819, by Capt. Alden Partridge, a graduate of the United States Military Academy and its superintendent during the years 1815-1817. It was called the American Literary, Scientific, and Military Academy, and it appears ("History of Norwich University," by William A. Ellis) to have been more of a military academy than a school of science. It was evidently modeled after the West Point school. The cadets lived in barracks, and were taken at as early an age as nine years. The curriculum included various languages, English literature, science, as much as was then known of engineering, and many military subjects, including military exercises. The academy was moved from Vermont to Middletown, Conn., in 1825, and was incorporated in that state, but was disbanded in 1829. In the meantime, Captain Partridge had left the academy in 1827, and had opened in Norwich a small preparatory school. When the academy was disbanded in Connecticut, he took its name again for his school, which in 1834 was chartered by the legislature of Vermont as Norwich University, and, in 1866, the university was moved to Northfield, in the same state.

"The second school was incorporated under the name of the Gardiner Lyceum, in Gardiner, Me., in 1822, and opened in 1823 by Benjamin Hale, who was graduated from Bowdoin College in 1818 and who afterwards became president of Hobart College. In his inaugural address, delivered Jan. 1, 1823, he said: 'It is the object of this institution to give instruction in those branches which are most intimately connected with the arts, and to teach them as the foundation of the arts.' 'It is not sufficient for them, as for the general scholar, to be taught the general laws of chemistry; they must be instructed particularly in the chemistry of agriculture and the arts. It is not sufficient for them to be able to repeat and to demonstrate a few of the general laws of mechanics; they must be taught the application of the laws. They must be made acquainted with machines.' The curriculum included various branches of pure mathematics, and natural science, mensuration, surveying, navigation, and theoretical and practical mechanics. The lyceum existed for about ten years. It was discontinued in consequence of the withdrawal of a legislative appropriation.

"The third school, which is the subject of this history, was founded in Troy, N. Y., by Stephen Van Rensselaer, of Albany, N. Y., in 1824. It was called the Rensselaer School, and was originated for the purpose of teaching the 'application of science to the common purposes of life.' Detailed information regarding it, including its early curriculums, will be given in due course in this history, and this reference is made at this time only to give the date of its foundation and its object, in order that a comparison may be made with the two schools previously mentioned.

"The primary object of the Norwich Academy was really not the teaching of applied science. It seems to have been a mixture of boarding-school, military academy, classical school and scientific school. Evidently more applied science, and even engineering, as it was then known, was taught than was taught in the classical colleges of that day. But even if, after all the changes in name and place, Norwich University may be said to be the same school as the American Literary, Scientific, and Military Academy, it is more than doubtful whether it has any right to be called the first school of science to be established in this country. If it has a claim to this distinction, the West Point Military Academy, after which it was modeled, has a greater claim; and this has never been made for it.

"Whatever honor may accrue from being the first school established in this country specifically for the purpose of teaching science belongs, I believe, to the Gardiner Lyceum, which was originated about two years earlier than the Rensselaer School, but which soon ceased to be. The Rensselaer Polytechnic Institute is, therefore, I believe, the first school of science and engineering, which has had a continuous existence, to be established in any English-speaking country."

Engineering schools, since 1819 at least, have not generally been established for the instruction of nine-year-old boys.

After the first edition of my history had been pub-

lished, the late Andrew D. White, in an address delivered at the unveiling of a monument to Benjamin Hale at Hobart College in 1911, called attention to the establishment of the Gardiner Lyceum and claimed that Hale, as its first principal, was the founder of the first technical school of the country. As I know of no other earlier school, I believe his statement to be correct.

The quotation from Hale's inaugural address given above seems to prove his contention. A copy of this address, together with several other pamphlets relating to the Gardiner Lyceum, is in the Bowdoin College library; at least these valuable documents were there several years ago.

PALMER C. RICKETTS,
President, Rensselaer Polytechnic Institute.
Troy, N. Y.

Diagram Indicates Where Weak Bridges Should Be Reinforced

Sir—In strengthening old bridges to carry heavier locomotives, the accompanying chart was found to be quite helpful in determining which members should be reinforced.

The full line indicates the live-load capacity of the

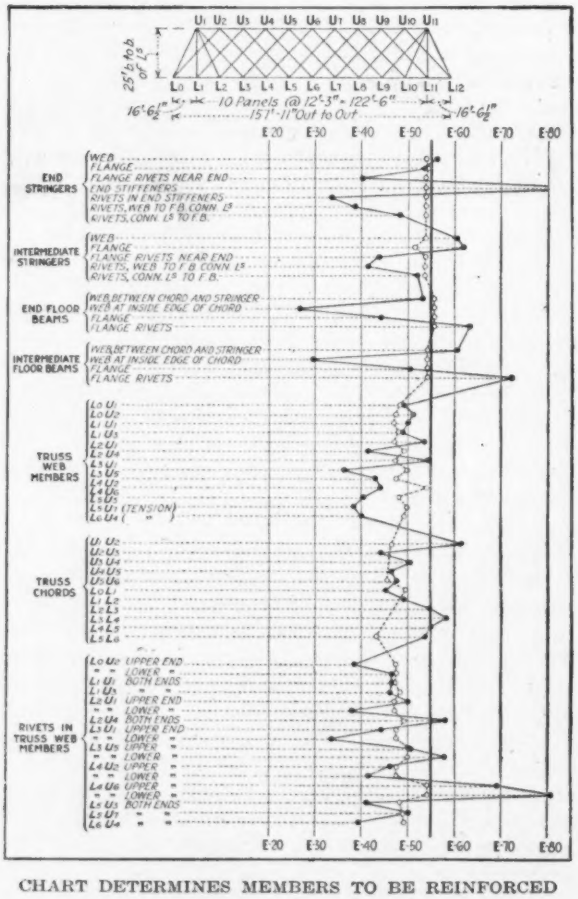

U1 U2 U3 U4 U5 U6 U7 U8 U9 U10 U11
25'b to b of Ch's
L0 L1 L2 L3 L4 L5 L6 L7 L8 L9 L10 L11 L12
16'-6½" 10 Panels @ 12'-3" = 122'-6" 16'-6½"
151'-11" Out to Out
E-20 E-30 E-40 E-50 E-60 E-70 E-80
END STRINGERS
INTERMEDIATE STRINGERS
END FLOOR BEAMS
INTERMEDIATE FLOOR BEAMS
TRUSS WEB MEMBERS
TRUSS CHORDS
RIVETS IN TRUSS WEB MEMBERS

CHART DETERMINES MEMBERS TO BE REINFORCED

various members in the bridge, reduced to Cooper's equivalent loading. The dash line represents a 240-ton mikado locomotive followed by a train of heavily loaded coal cars, reduced to Cooper's equivalent loading for the different members of the bridge. The heavy line was drawn at *E*-55, which is the standard loading used for designing by many railroads.

The diagram shows at a glance just which members are weak and the degree of weakness, enabling one to designate quickly and intelligently which members or parts should be reinforced.

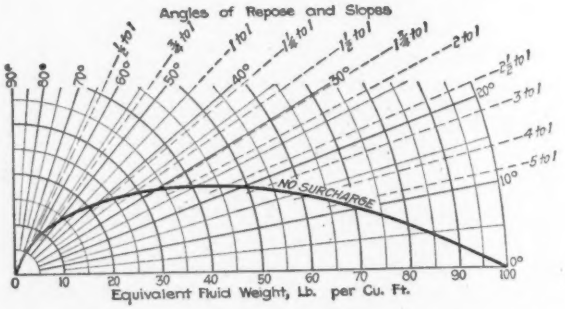
T. A. SMITH,
Structural Engineer, C. R. I. & P. Ry. Company.
Chicago.

Lateral Pressure of Saturated Earth by Equivalent Fluid Weight

Sir—The writer has read with considerable interest A. G. Husted's article on "Computing the Lateral Pressure of Saturated Earth" in your issue of Sept. 5, p. 441.

Mr. Husted's results are practically the same as those at which the writer has arrived, as given below, though the method of derivation is slightly different in the two cases.

Taking Mr. Husted's example, and referring to the diagram herewith, it is seen that the "equivalent fluid


Angles of Repose and Slopes
90° 80° 70° 60° 50° 40° 30° 20° 10° 0°
¼ to 1
⅜ to 1
1 to 1
1¼ to 1
1½ to 1
1⅞ to 2 to 1
2½ to 1
3 to 1
4 to 1
5 to 1
NO SURCHARGE
0 10 20 30 40 50 60 70 80 90 100
Equivalent Fluid Weight, Lb. per Cu. Ft.

EQUIVALENT FLUID WEIGHT BASED ON EARTH AT 100 POUNDS PER CUBIC FOOT

weight" for earth weighing 100 lb. per cubic foot, and with a slope of repose of 1½ to 1, is 28 lb. per cubic foot. Similarly, the "equivalent fluid weight" for earth weighing 70 lb. per cubic foot, and with a slope of repose of 2½ to 1, is $46 \times 70/100 = 32$ lb. per cubic foot. Therefore,

$$p_a = 28h$$
$$p_b = 46h + (32 + 62.5)h,$$

or, for Mr. Husted's example,

p_a at plane of saturation $= 28 \times 4 = 112$ lb.
p_b at plane of saturation $= (46 \times 4) + (32 + 62.5)0 = 184$ lb.
p_b at bottom $= (46 \times 4) + (32 + 62.5)6 = 751$ lb.

The writer has found this diagram of "equivalent fluid weights" based on Rankine's formula very useful, as it somewhat simplifies the calculations that are necessary.

The curve shown is plotted for a level fill only, but similar curves may easily be constructed for various angles of surcharge.

R. D. L. FRENCH.
Montreal, Que.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Table Gives Price of Team Haulage

A PRICE schedule for hauling, shown in the accompanying table, gives the cost of hauling one ton for various distances and at different rates per team per 10-hour day. It is based on an average load of 3750 lb., with team walking at two miles per hour with load and three miles per hour returning. An allowance of 40 min. is made for loading and unloading. This table has been prepared by E. B. Hiatt, county engineer of Madison County, Iowa, who says he has used it to good advantage in determining the cost of hauling materials for concrete work. This year the rate of $7 per team per day is being used.

SCHEDULE OF PRICES FOR HAULING ONE TON BY TEAMS FOR VARYING DISTANCES

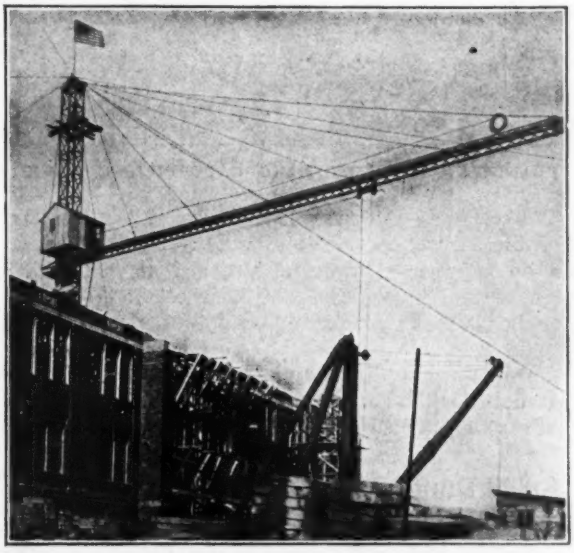
Team Rates per Day of Ten Hours

Miles	$5.00	$5.50	$6.00	$6.50	$7.00	$7.50
0 5	$0.288	$0.317	$0.346	$0.375	$0.404	$0.433
1 0	.400	.440	.480	.520	.560	.600
1 5	.511	.562	.613	.664	.715	.766
2 0	.622	.684	.746	.808	.871	.933
2 5	.733	.806	.880	.953	1.026	1.100
3 0	.844	.928	1.013	1.097	1.182	1.266
3 5	.955	1.051	1.146	1.242	1.337	1.433
4 0	1.066	1.173	1.280	1.386	1.493	1.600
4 5	1.177	1.295	1.413	1.531	1.648	1.766
5 0	1.288	1.417	1.546	1.675	1.804	1.933
5 5	1.400	1.540	1.680	1.820	1.960	2.100
6 0	1.511	1.662	1.813	1.964	2.115	2.266
6 5	1.622	1.784	1.946	2.108	2.271	2.433
7 0	1.733	1.906	2.080	2.253	2.426	2.600
7 5	1.844	2.028	2.213	2.397	2.582	2.766
8 0	1.955	2.151	2.346	2.542	2.737	2.933
8 5	2.066	2.273	2.480	2.686	2.893	3.100
9 0	2.177	2.395	2.613	2.831	3.048	3.266
9 5	2.288	2.517	2.746	2.975	3.204	3.433
10 0	2.400	2.640	2.880	3.120	3.360	3.600
10 5	2.511	2.762	3.013	3.264	3.515	3.766
11 0	2.622	2.884	3.146	3.408	3.671	3.933
11 5	2.733	3.006	3.280	3.553	3.826	4.100
12 0	2.844	3.128	3.413	3.697	3.982	4.266
12 5	2.955	3.251	3.546	3.842	4.137	4.433
13 0	3.066	3.373	3.680	3.986	4.293	4.600
13 5	3.177	3.495	3.813	4.131	4.448	4.766
14 0	3.288	3.617	3.946	4.275	4.604	4.933
14 5	3.400	3.740	4.080	4.420	4.760	5.100
15 0	3.511	3.862	4.213	4.564	4.915	5.266
15 5	3.622	3.984	4.346	4.708	5.071	5.433
16 0	3.733	4.106	4.480	4.853	5.226	5.600
16 5	3.844	4.228	4.613	4.997	5.382	5.766
17 0	3.955	4.351	4.746	5.142	5.537	5.933
17 5	4.066	4.473	4.880	5.286	5.693	6.100
18 0	4.177	4.595	5.013	5.431	5.848	6.266
18 5	4.288	4.717	5.146	5.575	6.004	6.433
19 0	4.400	4.840	5.280	5.720	6.160	6.600

Building Is Erected by Revolving Crane With 100-Foot Boom

A REVOLVING tower crane with a long horizontal boom carrying a trolley hoist has been built specially for the construction of the new high-school building at Galion, Ohio. This crane is shown in the accompanying view. The steel tower is 5 ft. square and 76 ft. high. It turns on a center bearing and is steadied at the top by guy cables fastened to a cap bearing. A lattice boom 100 ft. long is attached to the tower and has a track for the traveling trolley hoist. Cables from the top of the tower carry this boom, and the rear side of the tower is trussed vertically to resist bending stresses due to the loads on the boom.

The crane remains in one position, but is raised as the building progresses. It covers nearly the entire area, wheelbarrows being used to distribute material to parts not reached by the sweep of the boom. Open panels are left in the floors at the tower and will be closed after the crane is dismantled. Steel beams, concreting buck-



HORIZONTAL BOOM CARRIES HOISTING TROLLEY

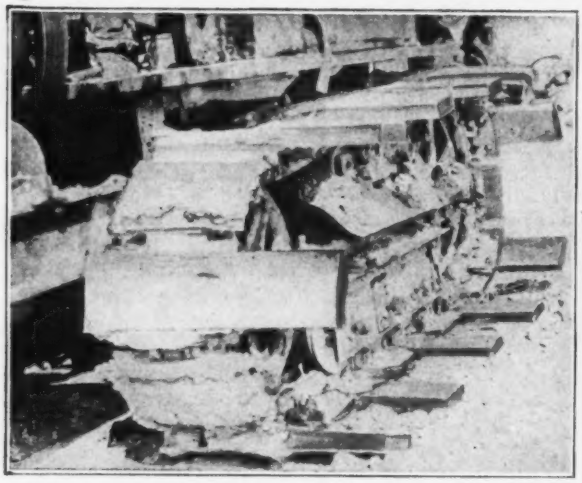
ets, timber, stone, skips of brick and other materials are handled by the hoisting trolley, which also serves to set beams, stone, etc., in position.

The operations are controlled from a cabin on the tower, just above the heel of the boom. There is an electric motor of 15 hp. for hoisting and another of 5 hp. for traversing the trolley. The hoisting capacity is 10 tons as far as the middle of the boom, and 5 tons at the extreme end.

This crane has been designed and patented by W. L. Willing and C. P. Klein, Bellevue, Ohio. The former is a member of the firm of Willing Bros., contractors for the high school; the latter is a member of the Klein Iron Works Co., which built the crane. A somewhat similar but double-arm crane, designed and used by Willing Bros., and described in *Engineering News* of May 13, 1915, p. 938, had a 130-ft. boom extending 64 ft. on each side of the tower.

Widened Wheels Carry Graders Over Mud

ROAD-BUILDING machinery working on the Great Salt Lake desert had trouble when heavy rains made the silty soil so soft that it would not support either the wheels or the caterpillar tractors. To increase the bearing areas of the machines, pieces of heavy plank were bolted to the tires of the wheels on the graders,



PLANKS INCREASE WIDTH OF CATERPILLAR TRACK

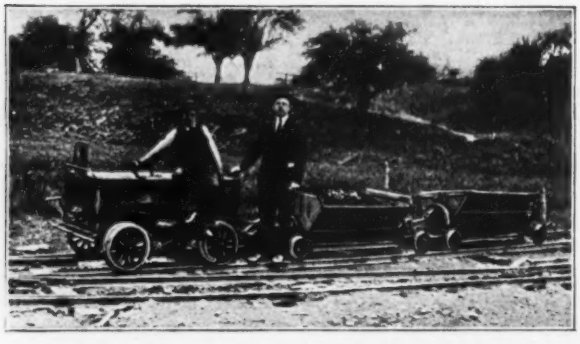
GRADER WHEELS WIDENED TO FORM A SKELETON DRUM

and likewise to the caterpillar tracks of the tractors. For the former an inside ring or false tire carried the outboard ends of the planks, and diagonal brace rods extended from the hubs of the wheels to the planks. For the planks on the caterpillars, however, no outboard support was practicable.

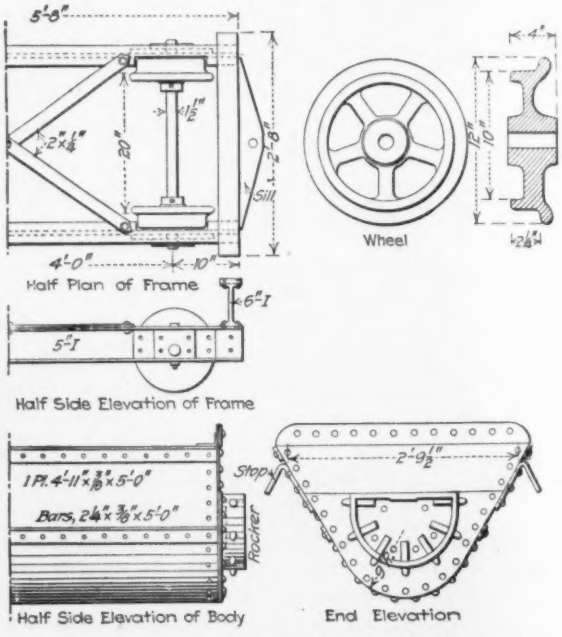
This method was improvised by R. E. Dildree, superintendent for the State Road Commission of Utah. Ira R. Browning is state road engineer.

Small Dump Car Helps Railway Ditching

TO FACILITATE the clearing of ditches along railway tracks a ¾-yd. side-dump steel car has been designed and built by the Baltimore & Ohio R. R. The car is operated on a track of 20-in. gage laid directly over the ditch, and is made low and narrow so as to clear trains in narrow cuts. One car can be loaded and handled by two men, but where the work is heavy and requires a long haul two or three cars are coupled



TRAIN USED FOR CLEARING DITCHES ON TRACK TWENTY INCHES WIDE



DETAILS OF CONSTRUCTION OF SMALL DUMP CAR FOR DITCHING WORK

and are hauled by a home-made motor car, as shown in the view. For this latter plan a larger crew is employed, with two trains, a switch and siding being put in at the end of the track so that one train can be placed for loading while the other is being taken away and dumped.

The dump cars contain a single plate forming the V-shaped shell, which is 5 ft. long, 3 ft. wide at the top and about 25 in. deep.

Rockers on the end plates have projecting lugs or teeth which engage with perforated castings on the end sills, and thus hold the body in position as it dumps. The rockers can be locked to prevent accidental dumping. The frame consists of two end sills resting on side sills, the latter being connected by diagonal bars and reinforced by plates at the holes for the axles. Cast-iron 10-in. wheels are secured to 1½-in. axles by set screws and give a wheelbase of 4 feet.

The design of the car was made under the direction of Earl Stimson, general superintendent of maintenance of way and structures of the Baltimore & Ohio Railroad.

NEWS OF THE WEEK

New York, December 12, 1918

Logan Waller Page

An Appreciation, by John M. Goodell

The sudden death in Chicago on Monday of Logan Waller Page will come as a deep shock, not only to the road builders of the country but also to his wide circle of acquaintances in every walk of life, who have come to admire his unusual executive ability and high character as a public official. Few men in public office in Washington, outside those holding positions of a political nature, have become so widely known and highly respected. The personal loss which is felt by all who have watched the wholehearted way in which he developed a great organization for the public welfare is something that cannot be expressed adequately at this time.

LOGAN WALLER PAGE

He had an ideal training for the work. He was a member of the first class at Harvard which specialized in road engineering. There were but two other members of this class, A. B. Fletcher and A. N. Johnson. The three have since, by their achievements, shown how well justified was the belief of Dr. N. S. Shaler that graduates from such a course were needed in this country. The unusual talents of Mr. Page as an investigator led him to become the geologist of the Massachusetts Highway Commission and director of its road-testing laboratory, the first laboratory of the kind in this country. He introduced here the methods of examining road materials which had been developed in France, and devised improvements of them, so that some years later, when the testing of road materials become a necessary part of the work of the Department of Agriculture, he was naturally selected as the

(Concluded on page 1098)

Reconstruction Problems Studied by Business Men

Atlantic City Meeting Favored Private Control, Coöperation of Labor and Capital, and Increase in Foreign Trade

Five thousand of the biggest business men in the United States got together at Atlantic City last week to formulate a program of industrial readjustment in the post-war period. Meeting first in small groups representing every phase of American industry, they came together later in progressively more inclusive subdivisions up to the last day, when the whole gathering met to consider—and, as it turned out, to approve—32 general resolutions boiled down by a representative committee from several hundred submitted by the major groups. In between there were three general sessions, at which the huge assembly listened with sympathetic and instant response to remarkable addresses by Henry A. Wheeler, Charles M. Schwab, Secretary of Commerce Redfield, James A. Farrell, Paul M. Warburg and John D. Rockefeller, Jr. The superficial result of the congress was the program outlined in the 32 resolutions; the real and more important result was the individual's reaction to the inspiration of the addresses, and the meeting of minds in the minor industrial groups.

The conference, which was called the War Emergency and Reconstruction Congress, was fathered by the Chamber of Commerce of the United States. This body called the meeting, had charge of all the arrangements, and paid the general expenses. It does not, however, assume responsibility for any of the actions of the conference. At the bottom of the progressively representative series of meetings were the war service committees, numbering some 300, which were organized during the past year to assist the War Industries Board. Following these were 35 related groups, embracing industries in the same general field, and finally there were 10 major groups receiving delegates from the related groups and reporting definite resolutions to the general congress. A clearance committee of 15 men, in which were representatives from each of the 10 major groups, was appointed by the president of the Chamber of Commerce to prepare the general resolutions intended to epitomize the hundreds of resolutions from the representative bodies.

In General Pershing's report of Nov. 20 to the Secretary of War, outlining the history of the American Expeditionary Forces, the commanding officer in France details briefly the remarkable work of the Engineer Corps in keeping pace with the ever-growing demands of the Army in the building of railways, wharves and storehouses. The report was made public Dec. 5. The section relating to the Engineer Corps closes with the following words of commendation:

"While the Engineer Corps has been referred to in another part of this report, it should be further stated that the work has required large vision and high professional skill, and great credit is due their personnel for the high proficiency that they have constantly maintained."

CLEARANCE COMMITTEE WORKED TO COLLATE COLLECTIVE THOUGHT

Such an organization, so completely subdivided and so extensive in its scope, threatened to be unwieldy, but in fact it functioned remarkably well. Each of the minor groups had its own individual problems of interest only to its own members. At the same time, each had broad views on the reconstruction issues which emerged from the minor groups and from them to the main convention. It was the duty of the clearance committee to take the general views expressed in unworkable multiplicity by the several group resolutions and sense from them the collective thought of the convention. It turned out, however, that the clearance committee disregarded most of the specific resolutions and, with some notable exceptions, confined itself to those which involved definite financial and economic necessities.

It was perhaps too much to hope that the congress would evolve a definite plan of reconstruction. The subject is too varied to permit of reduction to set terms, and too involved to be settled in a few days' conference. Some general principles, fundamental to the conduct of business, were set down as a guide to those intrusted with the national program, and a start was made on a permanent organization of the War Service Committees, which may be the nucleus of a nation-wide industrial organization in this country but which at present is intended to act with the Government should its services be asked in the reconstruction period. Primarily, the

resolutions stand for a better relationship of capital and labor, the return to pre-war conditions of industry, a policy of international good will, and a development of our foreign trade.

Through the whole congress ran the thread of the labor problem as the critical issue of reconstruction. President Wheeler accorded it first place in his preliminary address, Mr. Schwab emphasized it in his warning that in the future labor and capital must share equally in practice as well as in theory, and John D. Rockefeller, Jr., brought it to a climax in the enunciation of his industrial creed, printed elsewhere in this issue. No one could miss the feeling of the delegates; all were agreed that no further progress can be made without close coöperation between these two factors in industry. How that coöperation is to be worked out is still in nebulous form, but the congress adopted a resolution which heartily indorses "in letter and in spirit the principles of the industrial creed so clearly and forcibly stated by John D. Rockefeller, Jr., without approving or rejecting his particular plan or machinery."

GOVERNMENT OWNERSHIP OPPOSED

The congress was overwhelmingly against Government ownership. It recommended that all war restrictions be taken off industry, that the telegraphs, telephones and cables be returned now to private control, that the railways be returned to their owners, but under Federal charter, with such permitted coöperation as will "tend to economies without destroying competition in service." In fact, the watchword of the congress might have been that combination hitherto thought impossible "Competition with coöperation." Just how the advantages of both systems of economics are to be obtained was not explained.

A highly idealistic policy of foreign business relations was laid down. Foreign trade was recognized as a necessity, and its encouragement was advised in definite terms, but at the same time the interdependence of the nations of the world in this rebuilding period was accepted as manifest, and the general sharing of our food, raw materials, financial resources, and shipping "for the common service of all nations" was recommended. Plans were also laid for a committee of business men to go immediately to Paris to look into European conditions and be available for consultation by the American peace delegation.

On those specified problems of reconstruction in which the engineer is interested the resolutions were the weakest. This was undoubtedly due to the submersion of the engineer in the congress. A number of the prominent men in the profession were present, but they were there in an industrial capacity, as parts of organizations whose main functions are commercial, and as such they either did not or could not make any impression on the clearance committee, though they did succeed in getting some strong resolutions through the major groups.

The whole vital subject of construction was passed over in a brief resolution that "the development of public works should properly be resumed." A large merchant marine was recommended, but the method of its control was skilfully avoided. Some action, not specified, was urged on the Federal water-power bill. Public utilities should be made the subject of an investigation. Nothing was done in the matter of further highway construction, though several of the major groups recommended a national system of roads, and one group—that on heat, light and power—passed a resolution against such control. Irrigation, drainage, the use of cut-over lands, housing, and waterway transportation never emerged into the light of the whole congress.

Schwab Resigns from Emergency Fleet Corporation

Charles M. Schwab has resigned as Director General of the Emergency Fleet Corporation. President Wilson notified him by wireless that his resignation had been accepted, and expressed high appreciation of his services. Mr. Schwab, it was stated, is anxious to get back to his private affairs and will retire at once. It is announced that Charles Piez, vice-president and general manager of the corporation, will succeed Mr. Schwab.

Demobilization of S. A. T. C. Proceeding Rapidly

Reports received daily from the universities and colleges of the country indicate that the Students' Army Training Corps is being demobilized at a rapid rate, and that the institutions at which its units have been stationed are returning to a peace basis. Already a great number of institutions are no longer under military supervision, and usual courses of study are being pursued.

Reply to Request for Recognition of Engineers' Services

Under date of Dec. 4, G. H. Sines, chairman of the Federal Board of Railway Wage Adjustment, replied to the letter of Alfred D. Flinn, secretary of the Engineering Council, to Director General of Railroads McAdoo, requesting recognition for the services of engineers, as outlined in *Engineering News-Record* of last week, p. 1048. Mr. Sines' letter follows:

"Referring to your letter of Nov. 20 to the Director General of Railroads, calling attention to wages and working conditions of civil, mechanical and electrical engineers of various ranks and their technical assastants:

"This matter was taken up with the Director General, and this board has been advised that where such positions as those of engineers, assistant engineers, draftsmen and other men of technical training or experience, employed on the staff of the chief engineer of the valuation department or the general staff of the mechanical department, are not reached by the operation of supplements Nos. 7 and 8 to general order No. 27, their cases should receive special treatment at the hands of the Federal managers.

"If any of the employees in the service of railroads under Federal control in whom you may be interested feel that the provisions of wage orders affecting their positions are not being properly applied, it is suggested that they take their cases up with the division of labor in accordance with the provisions of circular No. 3, copy of which is attached for your information and guidance."

Bonds Sold To Push Hetch Hetchy Work at Full Speed

A million dollars' worth of 4½% Hetch Hetchy water-supply bonds were sold at par by the City of San Francisco to the Anglo and London Paris National Bank, which also took an option on the remaining $8,000,000 now authorized. The $1,000,000 will be used to carry on work at full speed during the next six or eight months. The $8,000,000 would cover the construction of the Hetch Hetchy dam and the first section of the aqueduct. Effort will be made to complete the work as far as the Moccasin Creek power development as soon as possible so the 60,000 hp. to be generated there will be made available for the use of the city.

Federal Supervision of State Research Favored

A permanent National Committee of Engineering Experiment Stations was organized at Washington Dec. 9, following a temporary organization in Massachusetts a few days earlier, and about two years of previous consideration. The Washington meeting was attended by some 15 men, mostly presidents or deans of American universities. The chairman was Richard C Maclaurin, president of the Massachusetts Institute of Technology, who was made head of the permanent organization. The committee, it is said, will support the Smith-Howard bill, which in an amended form will be pushed in the present session of Congress. With the proposed amendments the bill would place under the central direction of the United States Bureau of Standards the research work in engineering and agriculture conducted by the various states under Federal aid.

Abandoning Liberty Shipyard

Construction forces of the Liberty shipyard at Alameda, Cal., have been disbanded, and the contractor's office forces have completed their work and left. San Francisco news reports state that the entire project is to be abandoned as a result of the Emergency Fleet Corporation's decision to stop construction.

Founding Marburg Memorial Scholarship

A. S. T. M. Executive Committee Also Decides to Hold Special Memorial Meeting

The executive committee of the American Society for Testing Materials has authorized the founding of an Edgar Marburg Memorial Scholarship in the department of civil engineering of the University of Pennsylvania. Members of the society are invited to subscribe. The committee has also decided to hold a special memorial session commemorative of Dr. Marburg in connection with the next annual meeting of the society. Prominent men who stood in close personal relations with Dr. Marburg will speak.

The minute adopted by the executive committee is as follows:

"In the death of Edgar Marburg, which occurred on June 27, 1918, the American Society for Testing Materials has suffered the irreparable loss of one of its most eminent and distinguished members; its executive officer since its incorporation; a leader in engineering thought and education and in the field of testing materials.

ONE OF SOCIETY'S ORGANIZERS

"He was one of the small group which, in 1898, organized the American Section of the International Association for Testing Materials. In 1902 he was appointed acting secretary of the section. He at once prepared for the executive committee a clear, comprehensive statement of the purposes of a testing society, as he conceived them, which led to the incorporation of the society as an independent body. He was elected secretary and treasurer of the new society, and to him was entrusted the executive direction of its affairs. From then till his death, a period of 16 years, he worked assiduously for the success and advancement of the society. He devoted much time and thought to the work of its technical committees and the standardization of specifications and methods of tests of materials of engineering, and he shaped the policy under which these essential activities of the society are conducted. The marked success which has attended the work and growth of the society, and the interest and pleasures of its annual meetings, have been due in large part to his tireless and painstaking efforts. To his labors he brought great executive and organizing ability, excellent judgment, a clear grasp of the many and varied problems which confronted him, a sympathetic understanding of humanity, tremendous enthusiasm and zeal, and thoroughness in everything he undertook. His high ideals were reflected in every word and act. He was ever jealous of the good name of the society, and sought throughout his leadership to extend its usefulness in every proper field.

"To the officers and members of the executive committee, who were privileged to work intimately with him, his death brings a deep sense of personal loss and grief. His high integrity, his rugged honesty, his openmindedness, and his evident sincerity of purpose endeared him to his associates, and commanded their admiration, respect and devotion.

"The character and personality of Edgar Marburg have indelibly impressed themselves upon the American Society for Testing Materials—an inspiration to the society for all time."

MEMORIAL SESSION AT MEETING

"The executive committee has decided to hold a special memorial session, commemorative of Dr. Marburg, in connection with the next annual meeting of the society, at which prominent men who stood in close personal relation to him will be invited to speak. Announcement of the program and other details of this meeting will be made in a later circular to members.

MARBURG MEMORIAL SCHOLARSHIP

"The executive committee has authorized the founding of an Edgar Marburg Memorial Scholarship in the department of civil engineering at the University of Pennsylvania. It is the earnest belief of the executive committee that the great debt which the society owes to Edgar Marburg makes it peculiarly fitting that a permanent memorial shall be founded by the society, to which he ever gave the best of his efforts and his great abilities. His long and prominent services as an educator in the department of civil engineering at the University of Pennsylvania made it seem most appropriate that this memorial should be in the form of a scholarship in that department, thus associating in a bond of mutual interest the two institutions which owe so much of their success to his labors.

"Provost Edgar F. Smith of the University of Pennsylvania has advised the executive committee that a sum of $5000 is required to found a scholarship in engineering, and has expressed his sincere appreciation of the intention of the society. The executive committee believes that it voices the sentiment of the members of the society in expressing its feeling that this fund of $5000 should be raised by equal contributions of relatively small amount from all of its members, so that it may truly be said that the memorial is a tribute from the society as a body to its honored secretary-treasurer.

"The members of the society are accordingly asked to contribute the amount of $2.50 toward this memorial fund. The accompanying return card should be mailed with the remittance in the inclosed envelope addressed to the assistant secretary. Remittances should be drawn to the order of the American Society for Testing Materials. The executive committee desires that the announcement of the founding of this scholarship shall be made by the university authorities without undue delay, and it is accordingly asked that all contributions shall be in the hands of the assistant secretary not later than Jan. 15, 1919."

Railway Executives Urge Roads' Return

Resolutions Adopted at Meeting in New York for Private Operation of the Lines

At a meeting of the Railway Executives' Advisory Committee in New York City Dec. 4, resolutions were passed advocating restoration of the railroads to private corporations, opposition to Government ownership, acceptance of the principle of "reasonable, responsible and adequate Governmental regulation," adherence during the remaining period of Federal control to a policy of preparing the carriers for the readjustment, and provision by Congress of a system of Governmental regulation, which, while safeguarding the public, will be uniform, businesslike and empowered to deal equitably with wage and labor conditions. Representatives were present from practically all of the big trunk lines of the country.

At the close of the meeting T. De Witt Cuyler, chairman of the executives' committee, issued a statement which, in part, follows:

"Today's meeting showed that the railroad companies want a readjustment which will give the best possible system of transportation to the country. They neither expect nor wish to escape adequate responsible public regulation. They want a relation between rates, wages and dividends which will stimulate business, adequately reward labor and attract the volume of new capital needed for expansion. They want, therefore, regulation which is helpful and constructive, as well as corrective."

Canada Suggests Joint Development of St. Lawrence Power

The Canadian Government is preparing to take up the question of joint development with the United States of the water powers of the St. Lawrence River. A tentative scheme has already been submitted in its broad outlines, which, it is asserted, would, while providing increased navigation facilities, result in the development of enormous additional water power. It is proposed that surplus power generated under this scheme and not required in Canada could be exported to the United States under treaty arrangements providing for its return when needed in Canada. The adoption of the project would entail the practical abandonment of the present canal system, as the result of the creation of a deeper waterway by means of dams. This project is in accordance with the representations made to Washington some months ago, when the application of the St. Lawrence Power Co. was before the International Waterways Commission. It was urged then that instead of permitting a series of unrelated private enterprises to avail themselves of the water power, a comprehensive scheme of development should be carried out under public auspices by the two countries.

Logan Waller Page

(Concluded from page 1095)

Chief of the Division of Tests, which was established by the department in 1900.

From this small beginning as a research bureau in a great department, Mr. Page developed the Office of Public Roads, which I personally consider the greatest single influence in the country in developing an appreciation of the value of good roads to the community and of the importance to the taxpayers of conducting road work in a business-like manner, with due regard to good engineering practice. In 1905 the Division of Tests was consolidated with another division of the Department of Agriculture into the Office of Public Roads, and Mr. Page was made its director.

Early Work of the Bureau

The early work done by this bureau along technical lines was largely devoted to very close coöperation with the rather limited number of engineers who realized that the enormous sums spent annually in highway improvements were largely wasted through the ignorance of those entrusted with their expenditure. The work which the bureau did in helping these engineers, who were generally without adequate funds for carrying on investigations, was of the greatest value in placing highway engineering on a sound technical basis throughout the country. The enthusiasm of Mr. Page and the warm support given to his work by the successive Secretaries of the Department of Agriculture enabled the scientific and engineering resources at Washington to be utilized with maximum efficiency by road builders throughout the country. At this day, when so many of the state departments have their own laboratories, only those who know the value of the early work of the Office of Public Roads have any appreciation of the importance of its services to the country.

Roads Met With Opposition

The opposition to good road building in many parts of the country was quite active for some years after the Office of Public Roads was formed. There was a feeling that it was unnecessary to spend large sums in the improvement of alignment, the reducing of grades, the betterment of drainage, and the construction of hard-surfaced roads. Several organizations of what we would now call a profiteering nature were formed for the purpose of promoting road improvements. The self-elected officers of them obtained money from the people interested in road improvements in various districts, for the purpose of organizing conventions to discuss road building. This money mostly stayed in the hands of the promoters, and the so-called conventions were a menace to the development of popular interest in rational highway improvements. Mr. Page, accordingly, organized with a number of his friends the American Highway Association, which for some years carried on active educational work for the purpose of interesting influential men in road building. Under his guidance the association succeeded in playing an important rôle in convincing the public that road building should be entrusted to men of experience in such work, and that the financing of road improvements should be put on a sound economic basis. The work of the association was finished a year ago, but the organization during its few years of existence was of such value that the judgment of Mr. Page in organizing such a body was fully justified.

Man of Constructive Imagination

When the Federal-aid road law was passed, in 1916, the good organization which Mr. Page had developed in Washington was demonstrated by the promptness with which national coöperation in road building was undertaken. It was a new departure in public works. Some of the details involving the legal relations of the Federal Government and the states were so novel that it was necessary to feel one's way carefully through an uncharted sea In this difficult work the constructive imagination which was one of Mr. Page's great gifts proved invaluable.

Saw Complications Before They Arose, and Made His Plans

It was my good fortune to be able to see how this characteristic enabled him to sense possible complications long before they arose, and to have his plans ready to meet them. The road builders of the states, harassed by their own difficulties, cannot appreciate as yet the value of the help which Mr. Page rendered them through this gift, which few possess. It is the thing which bothers us on which our attention is fixed; we give little thought to those things which might bother us, but have been brushed from our path by the foresight of another. If there was any one thing that impressed me of late in the work of this gifted public officer, it has been the patient, constant forethought which he showed for the problems of the state highway departments and local road builders, and the innumerable instances of help given to them, of which they have little or no knowledge in most cases.

All States but One Assent To Federal-Aid Road Act

Legislative assent, required by the Federal-aid road act, has now been given by the legislatures of all states except Alabama, according to the annual report of the Office of Public Roads. The Alabama legislature meets only quadrennially, and its next regular session will convene in January, 1919, at which time, it is expected, the necessary legislative assent will be given. The Governor of Alabama has assented on behalf of the state, as authorized by the act, so that coöperation by the state has not been affected adversely.

Engineering Educators Welcome British Mission

Discuss War Lessons for Technical Instructors and Necessity for Broader Training

With the members of the British Educational Mission to the United States as guests and the problems of war and reconstruction up for discussion, the Society for the Promotion of Engineering Education held its 25th anniversary convention at Boston, Mass., Dec. 6-7. The prospect of an early strengthening of relations between educational institutions in the United States and Great Britain was a dominant note in the proceedings, and the sessions were marked by new appreciation of the importance of broadening and deepening the training of the engineer. The desirability of capitalizing some of the benefits of military discipline, for permanent use in character building by undergraduates, was generally recognized. A special session devoted to research united the members and delegates in asking that Federal support be given to a program to aid the United States in maintaining its new place in world leadership, and to facilitate its economic progress.

Favors Specialists in Lecture Rooms

Sir Henry Miers, F. R. S., vice-chancellor of the University of Manchester, spoke of the calling of industrial specialists into the lecture room as a most desirable factor in education. He said that in the north of England the feeling is growing that the student should gain practical experience in industrial works before entering upon the university course proper, and that it is a mistake to attempt to sandwich in works experience except during vacations. He thought too much attention is being given today to the needs of the rank and file of the profession, rather than to training men for the broadest and heaviest responsibilities. The universities in England are trying to get into closer touch with the industries. Firms are introducing scholarships for the purpose of training qualified young men for research. A strong demand for nonvocational training is now being met by the universities. The workers look with suspicion on any training which tends to increase their efficiency of production, but are seeking cultural education. In closing, Dr. Miers emphasized the importance of training engineers in industrial history and social economics. Dr. John Joly, of Trinity College, University of Dublin, emphasized the importance of carrying mathematics farther in engineering schools.

At a dinner Dec. 6 Sir Henry Miers expressed the thought that the mission might be considered as a "bridge across the Atlantic which shall be traversed by a continuous intellectual flow embodied in students and teachers passing between the two countries."

At the session Dec. 7 the opening ad-

dress was upon "The Effect of the War upon Engineering Education in the United States," by Dr. C. R. Mann, of the Joint Committee on Engineering Education. An abstract of Dr. Mann's paper is printed on p. 1069.

TRAINING ENGINEERS FOR THE ARMY

Maj. Gen. William M. Black, Chief of Engineers, U. S. A., outlined the duties of the military engineer in active war service and also under peace conditions, relating with appreciation how the engineering profession responded most patriotically to the country's call in the great war. He said that it was necessary to explain that, valuable as expert knowledge and ability are in war, the highest degree of all-around ability in engineering is demanded for combat service. Maximum versatility and not one-sided specialization is required. The tasks which must be done include, for example, the organization of a line for defense, including the consolidation of trenches, the construction of communication trenches, proper drainage, sanitation, communication, etc. In the rear the engineer is called upon to construct entire villages and cities; thus, a hospital of 25,000 beds required the construction of over 1000 separate buildings, 50 miles of piping, and also electric transmission lines. Long lines of warehouses are essential at the supply depots, all electrically illuminated and supplied with water, sewers, railway yards, piers, etc.

In a brief discussion of General Black's address, Prof. J. C. Olson, of the Rensselaer Polytechnic Institute, contended that the use of the military method in education does not encourage originality or inventive faculties, and maintained that engineering education should not lose sight of the importance of producing technical specialists. The speaker deprecated the production of engineers with too much all-around training. Professor M. I. Pupin, of Columbia University, said that he had found a West Point graduate far ahead of others in usefulness in certain research work, and he felt that military discipline was of great value and that American universities are deficient in the matter of disciplinary emphasis.

TIME TO SUPPORT RESEARCH

That the time has arrived to urge Federal support of research and to plan for its development along comprehensive lines, was the unanimous opinion of a session devoted to this subject, in which President Richard C. Maclaurin, of the Massachusetts Institute of Technology, emphasized the importance of bringing the matter before Congress in a united front. He said that the country should now make adequate provision for science in all its branches, aiming at a great Federal organization comparable to present Government departments. He described the main features of the Smith-Howard bill now before Congress, under which $15,000 per year, and ultimately $30,000, will be appropriated for research in each state, and distributed through the state legislatures. He thought the bill too narrow in its present form, but emphasized the importance of agreeing in order to obtain action at this time.

Professor Pupin suggested that the Smith-Howard bill might well be amended to provide for the distribution of the Federal aid through a committee of five scientific men in each state, to be appointed by the Governor or the state legislature. During the discussion it was pointed out that there are certainly six institutions in this country to which should be granted at least $100,000 a year each for research, in proportion to their facilities and staffs. President Thompson, of Ohio State University, urged the importance of encouraging state aid to research as well as Federal assistance.

At the final session, a general discussion of educational methods emphasized the amazing speed and success of military training under the selective service law, and developed the thoughts that patriotism of peace must succeed patriotism of war among students; that theoretical instruction must fall within the understandable range of practice, and that inventive adaptability to meet immediate problems is not necessarily antagonistic to military training methods.

John D. Rockefeller, Jr.'s Industrial Creed

Principles He Laid Down at the Reconstruction Congress at Atlantic City

1. I believe that labor and capital are partners, not enemies; that their interests are common interests, not opposed, and that neither can attain the fullest measure of prosperity at the expense of the other, but only in association with the other.

2. I believe that the community is an essential party to industry and that it should have adequate representation with the other parties.

3. I believe that the purpose of industry is quite as much to advance social well-being as material well-being and that in the pursuit of that purpose the interests of the community should be carefully considered, the well-being of the employees as respects living and working conditions should be fully guarded, management should be adequately recognized and capital should be justly compensated, and that failure in any of these particulars means loss to all four.

4. I believe that every man is entitled to an opportunity to earn a living, to fair wages, to reasonable hours of work and proper working conditions, to a decent home, to the opportunity to play, to learn, to worship and to love, as well as to toil, and that the responsibility rests as heavily upon industry as upon government or society, to see that these conditions and opportunities prevail.

5. I believe that industry, efficiency and initiative, wherever found, should be encouraged and adequately rewarded, and that indolence, indifference and restriction of production should be discountenanced.

6. I believe that the provision of adequate means of uncovering grievances and promptly adjusting them is of fundamental importance to the successful conduct of industry.

7. I believe that the most potent measure in bringing about industrial harmony and prosperity is adequate representation of the parties in interest; that existing forms of representation should be carefully studied and availed of in so far as they may be found to have merit and are adaptable to the peculiar conditions in the various industries.

8. I believe that the most effective structure of representation is that which is built from the bottom up, which includes all employees, and, starting with the election of representatives in each industrial plant, the formation of joint works' committees, of joint district councils, and annual joint conferences of all the parties in interest in a single industrial corporation, can be extended to include all plants in the same industry, all industries in a community, in a nation, and in the various nations.

9. I believe that the application of right principles never fails to effect right relations; that "the letter killeth and the spirit maketh alive"; that forms are wholly secondary, while attitude and spirit are all-important, and that only as the parties in industry are animated by the spirit of fair play, justice to all and brotherhood, will any plans which they may mutually work out succeed.

10. I believe that that man renders the greatest social service who so cooperates in the organization of industry as to afford to the largest number of men the greatest opportunity for self-development and the enjoyment by every man of those benefits which his own work adds to the wealth of civilization.

Puget Sound Continues Fast Work In Shipbuilding

On its third ship to be launched the Seattle North Pacific Shipbuilding Co., Seattle, Wash., made a record of 81 days from keel-laying to launching, according to the *Emergency Fleet News* of Dec. 5. The vessel was the "Iconium," a 9400-ton ship, launched Nov. 26. The first ship of the yard was launched in 84 days.

Milwaukee Plans $3,100,000 for Public Works in 1919

In anticipation of the necessity of providing employment for men relieved from duty in war industries, the Department of Public Work of Milwaukee, Wis., is considering the advisability of preparing and providing for unusually large expenditures next year. Projects will be submitted to the board of estimate which prepares the budget

for recommendation to the city council. The projects to be proposed include the following: New bridges, $500,000; track depression, $500,000; street work, $400,000; viaduct repairs and reconstruction, $350,000; harbor improvements, $250,000; sewer extensions, $100,000. Besides the above works, totaling about $2,100,000, are those contemplated by the school board and the sewerage commission, which have new and deferred works on hand amounting to about $1,000,000, all of which could be started next year if necessary.

Announce Local Correspondents of Engineering Council

During the past few months some twenty-five men have been selected by the Engineering Council as correspondents. It will be their function to transmit notes on the activities of the Engineering Council to engineers in all branches of the profession in their respective localities, to send information and suggestions appropriate for the attention of the Council, etc. The list of those selected follows:

Anaconda, Mont.	C. D. Demond, Anaconda Copper Mining Co., 704 Main St.
Atlanta, Ga.	A. M. Schoen, Trust Co. of Georgia Bldg.
Buffalo, N. Y.	Edmund B. Neil, Sec., Engineering Society of Buffalo, Pierce-Arrow Motor Car Co.
Butte, Mont.	E. B. Young, Sec., Montana Section, A.I.M.E., 526 Hennessey Bldg.
Chicago, Ill.	E. S. Nethercut, Sec., Western Society of Engineers, 1735 Monadnock Block.
Cleveland, Ohio	Arthur F. Blaser, Sec., Cleveland Engineering Society, 830 Leader-News Bldg.
Denver, Colo.	Fred J. Rankin, Colorado Public Utilities Commission, State Capitol.
Detroit, Mich.	D. R. Williamson, Sec., Detroit Engineering Society, Detroit Board of Commerce.
Duluth, Minn.	W. H. Woodbury, Sec., Engineers' Club of Duluth, 401 Wolvin Bldg.
Iowa City, Iowa	John H. Dunlap, Sec., Iowa Engineering Society.
Miami, Gila Co., Ariz.	B. B. Gottsberger, General Manager, Miami Copper Co.
Milwaukee, Wis.	Fred H. Dorner, Sec., Milwaukee Engineering Society, Wells Bldg.
New Orleans, La.	John Klorer, Pres., Louisiana Engineering Society, 8300 Panola St.
Portland, Ore.	George C. Mason, Gasco Bldg.
Reno, Nev.	H. M. Rives, Sec.-Treas., Nevada Mine Operators' Association.
Sacramento, Cal.	Austin B. Fletcher, State Highway Engineer, Forum Bldg.
Salt Lake City, Utah.	Leonard Cahoon, Pres., Utah Society of Engineers, Gallagher Machinery Co.
St. Louis, Mo.	John W. Kerr, Sec., Engineers' Club of St. Louis, 3817 Olive St.
St. Paul, Minn.	George H. Herrold, Sec., Minnesota Joint Engineering Board, Room 72, City Hall.
San Francisco, Cal.	Nathan A. Bowers, Sec., San Francisco Engineers' Club, Rialto Bldg.
Seattle, Wash.	Amos Slater, Sec., Associated Engineering Societies of Seattle, 445 Henry Bldg.
Spokane, Wash.	Alfred D. Butler, Sec., Spokane Engineering and Technical Association, City Hall.
Trenton, N. J.	Joseph E. English, Sec., Trenton Engineers' Club.

It is expected that correspondents will be selected in a few other places in the near future.

Public Health Progress and Some Needed Reforms

Presidential Address Holds Up New Standards—New Jersey Health Board Stagnant

Called to France on the mission announced in *Engineering News-Record*, Nov. 28, 1918, p. 1003, George W. Fuller was unable to present in person his presidential address before the 44th annual meeting of the New Jersey Sanitary Association at Lakewood Dec. 6. The address, which was read by the secretary, was on "Recent Developments in Health Work." In the course of his paper Mr. Fuller said: "It is well for all sanitarians to bear in mind a view which has sprung up in many localities during recent months; that is, that it is frequently of more importance to extend the sewer system of a community than it is to perfect or even to commence the installation of sewage treatment works." In line with this general thought, Mr. Fuller said, later on: "A sound perspective is needed at the present time in revamping the whole question of appropriations made in a sanitary field, with a view to seeing that money is spent in a manner to do the greatest good." A summary, contained in the concluding paragraph follows:

SUMMARY OF THE ADDRESS

"Old-world standards of life for nations and individuals have passed. In the course of our struggle to make the new-world ideas effective, we have learned some lessons which should be utilized as we bring our daily existence back to a normal plane. It is the duty of sanitarians in this state to make our people realize the scope of modern sanitation and see what a defense it is. Great advance in elimination of waterborne diseases has been shown, but education is still needed in our communities to show that these diseases probably cannot be further checked without eliminating insect carriers and securing general municipal cleanliness. Social disease has seriously lowered the strength of our population, and the improvement effected during military service must be carried ahead by civilian agencies. These are tasks for which the engineer and the doctor are to join their functions in harmonious teamwork. Public health work must be balanced, amply financed and well planned to secure a maximum total benefit for every dollar expended. Great, sudden contingencies and local exigencies must be provided for. Municipal sanitarians must keep out of ruts on the one hand; but on the other hand must not develop, in their enthusiasm for excursions into new fields, inertia toward broader and less interesting projects."

Invited to discuss "Some Needed Reforms in Public Health Work," M. N. Baker, of the editorial staff of *Engineering News-Record*, centered his remarks on needed changes in the New Jersey State Department of Health. He said in part: "Only a few days ago a close observer deplored the unprogressiveness of the department. 'It is not even drifting,' he said; 'it is stagnant.' My own conviction, based partly upon personal experience as a member of the reorganized board, is that the efficiency of the department would be greatly increased if the board were swept out of existence or restricted to advisory duties, and all the executive functions of the department were centered in a single commissioner, as is the practice now in New York, Pennsylvania, Massachusetts, Maine, Connecticut, Ohio, West Virginia and Oklahoma.

"The statute reorganizing the department is sound in most of its fundamentals. It goes far in separating the legislative and executive functions of the department and in making the director the chief executive officer. But it establishes a considerable division of responsibility. The director has surrendered and the board has assumed powers plainly vested in the director, but the board, like such boards in general, is not properly constituted for quick and efficient executive work. The result is circumlocution, delays, postponements, the killing of initiative, and general discouragement of the bureau chiefs and assistant director, who are the departments life and working force.

"The department lacks a living, growing plan of health protective work, coupled with a real budget. It has lacked the courage, the initiative, the vision to determine what's what in public health work, to establish relative values in terms of costs. Granted full powers to frame and enforce a statewide health code and to see that local boards enforce the code and the state health laws generally, the department has been slow in drafting the code and slower yet in seeing that local boards do their full duty to their communities and the state."

URGES REFORM OF DEPARTMENT

Concluding, Mr. Baker urged that the New Jersey State Department of Health be reformed so it may become "a leader in these critical times, doing not alone such direct work as belongs to it, but serving also to point the way in local health administration—which, after all, is the vital thing—leading where local departments need leadership, compelling where without compulsion the public health will not be protected."

A resolution was adopted requesting the legislative committee to take steps to secure an amendment to the state health law confining the State Board of Health to advisory functions and giving the director mandatory power.

The election of officers resulted in the choice for president of Charles J. Fisk, formerly mayor of Plainfield; chairman of the executive council, John H. Gregory, consulting engineer, New York City; secretary, Lieut. Edward Guion, M. R. C., U. S. A., and acting secretary, Dr. C. W. Crankshaw, East Orange, the last two being reëlected.

A. S. M. E. Meeting Stresses Human Problems

Large Part of Discussion at Annual Sessions Devoted to "Engineering of Man-Power"

At the annual meeting of the American Society of Mechanical Engineers, held in New York last week, the sessions which attracted the largest attendance were those devoted to the "Engineering of Man-Power," as the program phrased it. A terse summing up of the situation confronting the engineer was given in an after-luncheon address by Dr. George W. Kirchwey, late dean of the Columbia University Law School. Dr. Kirchwey declared that the engineer, by his development of machinery and his organization of industry, has revolutionized the whole social organization and brought the world face to face with appalling social problems. "You have got us into this mess," said Dr. Kirchwey, "and it is up to you to get us out of it."

The session on the "Engineering of Man-Power" opened with an address by Dr. L. S. Rowe, assistant secretary of the treasury. Dr. Rowe, who is a member of the faculty of the University of Pennsylvania, is well known as one of the leading experts in the United States on conditions in South and Central America. The main topic of his address was the position of the engineer from the United States undertaking work in Spanish-American countries. While giving to the American engineers who have carried out work there high credit for technical ability, ingenuity in overcoming obstacles, and "driving power" in completing work in a minimum time, Dr. Rowe said that observation had convinced him that engineers from the United States very generally failed to cultivate good relations with the native workmen and did not even try to understand their personality and point of view.

In a paper entitled "Standardization and Administration of Wages," Henry C. Kendall and Earl B. Howard discussed the changed relations between employers and labor likely to result from the war. The authors believe that joint boards of employers and employees to deal with the wages and working conditions of an entire industry are likely to become permanent and be adopted in many industries. The authors estimate that these joint boards will eliminate at least three-fourths of the present friction and strife between employers and workmen.

In a paper entitled "Nonfinancial Incentives," R. M. Wolf, manager of the Spanish River Pulp & Paper Mills of Sault Ste. Marie, Ont., described the manner in which he had greatly increased the production of the plants under his care by educating the men in the technical details of their work and then keeping them informed, by up-to-date progress records, of their relative efficiency, week by week, so that they took pride in keeping up and improving their records. In the repair department, by giving the men who carried on the repair work a record showing the cost of the materials which they used, the cost of these materials was reduced more than one-half in the course of two years. This paper brought out active discussion, the purport of which was that while such nonfinancial incentives were excellent, a very much higher degree of efficiency was obtained when the workman was given a financial incentive as well for doing his best.

In a paper on "The Employment of Labor," Dudley R. Kennedy, employment manager of the Hog Island shipyard for the American International Corporation, described the difficulties experienced in maintaining the labor supply on this enormous job. How huge the task was may be judged from Mr. Kennedy's statement that the rate of money expenditure at Hog Island was five times as great as on the Panama Canal.

The vocational instruction carried on by the War Department Committee on Education and Special Training was described by C. R. Dooley, director of the work. The committee was appointed in February, 1918, with instructions to train 90,000 men in the six months from Apr. 15 to Nov. 15, allowing two months as the length of each course of training. There were established 140 vocational schools in educational institutions scattered in all parts of the country, and the work was carried out according to schedule, approximately 100,000 men being trained during that time in some 30 different trades.

Charles Piez, vice-president of the United States Shipping Board's Emergency Fleet Corporation, described the organization which had been developed to conduct that enormous enterprise. The corporation is responsible for a total expenditure of nearly $4,000,000,000, involving the construction of vessels for the American merchant marine aggregating some 15,000,000 tons, dead weight.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 9-13, Chicago.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 West 39th St., New York City; Jan. 15-16, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION; 150 Nassau St., New York City; Feb. 25-28, New York City.

The American Society for Testing Materials has appointed the following representatives on the American Engineering Standards Committee, in which the society recently voted to participate: A. A. Stevenson, A. W. Gibbs, and J. A. Capp, appointed to serve one, two and three years, respectively.

The Engineers' Club of Trenton, N. J., will hold its annual meeting tonight. Captain Sapelli, of the Italian Commission, will deliver an address on "Italian Participation in the World War," illustrated with lantern slides. The annual report of the board of governors of the club will be received, and officers will be elected for the coming year from the following nominations: President, Charles R. Fairchild; first vice-president, Alfred P. S. Bellis; secretary, Joseph E. English.

The Louisiana Engineering Society was addressed Dec. 9 by William T. Hogg, who spoke on "Suggested Changes in the Operation of the Street-Car System in New Orleans."

The Brooklyn Engineers' Club will hold its annual meeting tonight. The annual report of the board of directors will be received, and election of officers made from the following nominations: President, Frank W. Skinner; vice-president, Herbert B. Morrison; secretary, Joseph Strachan; treasurer, Carroll S. Dunphe. The annual dinner will precede the meeting.

The Detroit Engineering Society held a meeting Dec. 6, at which H. W. Clausen, vice-president of the American Association of Engineers and assistant city engineer of Chicago, delivered a paper on "The Relation of the Engineer to Business and Social Problems." J. H. Herron spoke regarding the joint membership plan between the American Association of Engineers and the Cleveland Engineering Society.

The Engineers' Club of Philadelphia will be addressed by Commander F. G. Coburn, U.S.N., manager of the naval aircraft factory at the navy yard, Philadelphia, on "Airplane Construction," at the weekly luncheon on Dec. 17.

PERSONAL NOTES

C. T. HENDERSON has resigned as chief engineer of the Submarine Boat Corporation and has become chief engineer of the Hercules Engineering Corporation, New York City, and president of the Electrolytic Engineering Corporation. Prior to his association with the Submarine Boat Corporation Mr. Henderson was general manager of the Niagara Smelting Corporation, Niagara Falls, N. Y.

D. E. HELVERN, division engineer, Atchison, Topeka & Santa Fé

Ry., with headquarters at Pueblo, has been appointed district manager, northern district, Atchison, Topeka & Santa Fé Ry., succeeding J. A. Gillies, who has been appointed trainmaster at Dodge City, Kan., as noted elsewhere.

F. L. NICHOLSON, consulting engineer, Virginian Ry., with headquarters at Norfolk, Va., has been appointed chief engineer.

J. A. GILLIES, district engineer, northern district, Atchison, Topeka & Santa Fé Ry., has been appointed trainmaster at Dodge City, Kan.

B. WHEELWRIGHT, acting signal engineer, Grand Trunk Ry., Canadian lines, with headquarters at Montreal, has been appointed engineer maintenance of way, New England lines, with headquarters at Portland, Me.

C. N. BAINBRIDGE has been appointed engineer of design, Chicago, Milwaukee & St. Paul Ry., with headquarters at Chicago, succeeding H. C. Lothholz, resigned.

G. R. BARRY, division engineer, Pennsylvania Lines at Columbus, Ohio, has been transferred to the Chicago division.

C. F. LOWETH, chief engineer, Chicago, Milwaukee & St. Paul Ry., with headquarters at Chicago, has been appointed also chief engineer of the Port Townsend & Puget Sound Railway.

J. H. LIBBERTON, division engineer, promotion bureau, Universal Portland Cement Co., has been appointed inspecting engineer and engineer of the promotion bureau, succeeding William M. Kinney, whose appointment as general manager of the Portland Cement Association was noted in *Engineering News-Record* of Dec. 5, p. 1051. Mr. Libberton has been with the company since 1908.

J. L. CAMPBELL, engineer, maintenance of way, El Paso & Southwestern R.R., has been appointed chief engineer. Mr. Campbell entered engineering work in 1888 as deputy county surveyor of El Paso County, Texas, later becoming city engineer of El Paso, after which he was in charge of various location projects on railway systems in Texas, New Mexico and Mexico.

A. T. MERCIER, previously assistant district engineer, southern district, and division engineer, San Joaquin division, Southern Pacific Co., has been appointed division superintendent, with headquarters at Portland. In 1904 he entered the service of the Southern Pacific on the Los Angeles division as roadmaster's clerk and transitman, later becoming general foreman and engineer in charge of terminal construction at San Pedro, Cal. In 1909 he became assistant division engineer, Los Angeles division, and was later made district engineer of the southern district. In 1912 he was appointed division engineer of the San Joaquin division.

F. M. GRAHAM, division engineer, Pennsylvania Lines, with headquarters at Chicago, has been appointed supervising engineer, southwest system of the Pennsylvania Lines, with office at Columbus, Ohio.

E. A. WHITMAN, chief engineer, Minneapolis, St. Paul & Sault Ste. Marie Ry., with offices at Minneapolis, has been appointed also chief engineer, Lake Superior Terminal & Transfer Railroad.

L. L. HIDINGER, vice-president of the Morgan Engineering Co., Memphis, Tenn., has been appointed chief engineer of the Little River Drainage District, succeeding the late William A. O'Brien, whose death was noted in *Engineering News-Record* of Oct. 24, p. 781. Mr. Hidinger was graduated from Iowa State College in 1906, after which he became drainage engineer, bureau of drainage investigations, United States Department of Agriculture, in Illinois. Since that time he has been continuously engaged in drainage and reclamation work. In 1910 he became vice-president of the Morgan Engineering Co., and has been in charge of reclamation projects in various parts of the country.

EDWARD GAGEL, chief engineer of the New York, New Haven & Hartford R.R., has been appointed also chief engineer of the Central New England Ry., New York Connecting R.R., Wood River Branch R.R., Union Freight R.R., the Narragansett Pier R.R., the Boston Terminal, the New England Steamship Lines, the Hartford & New York Transportation Line and the New Bedford, Martha's Vineyard & Nantucket Steamship Line.

CHARLES A. WHITMORE, Visalia, Cal., has been appointed on the California State Highway Commission, succeeding Henry J. Widenmann, whose death was noted in *Engineering News-Record* of Oct. 24, p. 781.

FRANK H. FOWLER, engineer and architect, Seattle, has removed his office to 2006 L. C. Smith Building.

CHARLES F. STERN, one of the three members of the California Highway Commission, has been appointed state superintendent of banks. Mr. Stern is a graduate of the University of California. He served on the State Board of Education in 1913, and since January, 1914, on the State Highway Commission. His successor has not yet been named.

ARCHIBALD W. CAMPBELL, recently deputy minister of railways and canals for the Dominion of Canada, has been appointed a commissioner to investigate and report to the Canadian Government on the question of good-roads construction. Mr. Campbell was for many years deputy minister of public works for Ontario and was the practical founder of the good-roads movement of that province.

SAMUEL T. WAGNER has resigned as chief engineer of the Philadelphia & Reading Ry. under Federal Manager Charles H. Ewing, to become corporate chief engineer of the Philadelphia & Reading Railway Co., with headquarters at Philadelphia.

OBITUARY

LOGAN WALLER PAGE, director of the United States Office of Public Roads and Rural Engineering, died suddenly in Chicago, Dec. 9, while in attendance at the annual meeting of the American Association of State Highway Officials. He was born in Richmond, Va., in 1870, and was a student in engineering at Virginia Polytechnic Institute for two years and at Harvard University for six years. Later, at Harvard, he was in charge of tests of all materials used by the Massachusetts Highway Commission and some for other states and Canada. In 1899 he made an extended study of road building in Europe. A year later, he became chief of the road material laboratory, United States Government, afterwards reorganized as the Division of Tests. In 1904 he became director of the Office of Public Roads, which combined the Division of Tests and the Office of Public Roads Inquiry, in the Department of Agriculture. In 1908, Mr. Page acted as chairman of the commission to represent the United States at the International Road Congress in Paris. An appreciation of his life and work, by John M. Goodell, appears on page 1095.

CAREY S. PRATT, formerly bridge engineer for Mercer County, New Jersey, died recently at his home in Trenton, N. J. He attended Ohio State University and in 1892 became deputy county surveyor of Noble County, Indiana. Afterward he served as city engineer of Sidney, Ohio, and later became resident engineer of the Dayton, Springfield & Urbana Electric R.R. and chief engineer of the Springfield & Xenia R.R. In 1902 he became city engineer of Urbana, Ohio, later removing to Trenton, N. J., where he became bridge engineer for the county.

EDWARD ALLEN WICKES, president of the Niagara Falls Power Co., died recently in New York City. He was also a director in the Tonawanda Power Co., Cataract Power & Conduit Co., and the Canadian Southern Ry. Company.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Construction Industries Form National Organization

At the convention of representatives of construction industries last week at Atlantic City, a national organization was formed. It has been named "The National Federation of Construction Industries." All war service committees interested in construction industries, and all associations of architects, contractors, engineers, and manufacturers, and dealers in building materials, were invited to send delegates with power to act in planning a policy and program for the future. At the meetings reports were received on the activities of the central war service committee of the building industries, for the creation of which the national federation was originally organized; committees were appointed and reports received. In his remarks at the opening of the meeting, Chairman Ernest T. Trigg stated that the views of leaders in the various branches of the construction industry throughout the country were solicited, and it was the consensus of opinion that a permanent organization was desirable at this time.

The report of the meeting states that nine of the 32 resolutions passed by the conference were of special interest to the construction industries. They were, on removal of restrictions on industries, cancellation of war contracts, disposal of surplus government supplies, relocation of labor, immediate development of public works, extension of port and terminal facilities, development of water power; research connected with forest products, and uniform methods of cost accounting.

Resolutions were also passed advocating the development of foreign commerce and the sending of a committee of American business men to attend the sitting of the peace conference.

Shipbuilding Restraints Lifted by Shipping Board

The war-time restraints on wooden and steel ship construction have been removed by the United States Shipping Board, in so far as the acceptance of contracts for building vessels for private accounts is concerned. In regard to wood construction, the American shipbuilders may now solicit and accept orders and carry forward the work of construction and enter into contracts for the sale of ships, on completion, without restraint. The same action with reference to steel ships is announced, but applying to domestic orders only. The Shipping Board announced that this action is in accordance with the progressive release of business from war-time restrictions, and is not dictated by any special consideration.

Labor Turnover Reduced and Financial Saving Effected by Better Housing

Important Economic and Engineering Problems Discussed at Meeting of National Housing Association

Housing and transportation have been found to be the most important factors in the turnover problem, next to actual labor conditions within the plant. These conclusions were presented in papers read before the convention of the National Housing Association recently held in Boston, and are the results of a nation-wide study of the housing problem. The studies emphasized the engineering phases of building construction, town planning, and urban and suburban transportation, and show that the solution of the problem will result in saving a large amount of money, by the reduction or elimination of labor turnover.

Capt. Boyd Fisher, chief of the employment management division of the War Industries Board, in his paper entitled "Good Housing as a Reducer of Labor Turnover," stated that "it serves a manufacturer's strictly business interests to build houses for his workmen." He added that the proof of this will be found in the record of companies whose labor turnover has been reduced by the provision of sufficient and decent housing accommodations, as against those who have neglected the problem.

Lack of Houses Shown

Captain Fisher briefed the reports of the field agents of the United States Housing Corporation, and brought to light the "deplorable situation in lack of housing that exists throughout the industrial centers of the country." The reports cover the shipbuilding plants of the Atlantic coast, the general manufacturing centers in Ohio and the Central West, industrial centers in the South, the lumber industry in the Northwest, and the agricultural regions of California. Such conditions as men occupying the same bed in three relays, two to eight men quartered in the same room, and families living in cellars and garrets, are exposed. The reports state that "employers interviewed without exception consider that housing shortage is a very important, if not the principal, cause of high turnover." In one plant employing many hundreds of men the turnover was found to be over 30% per month, and the company estimated that by solving the housing problem it would save $200,000 a year.

The actual working out of good housing conditions, as compared with poor housing, is illustrated in the blast-furnace section of Pennsylvania. One company had two blast furnaces about 20 miles apart, between which was the blast furnace of a rival company. The housing facilities of the first company are considered superior to that of the other, and it was found that for a number of years the second company has had to pay all its men a higher rate per day for the same number of hours.

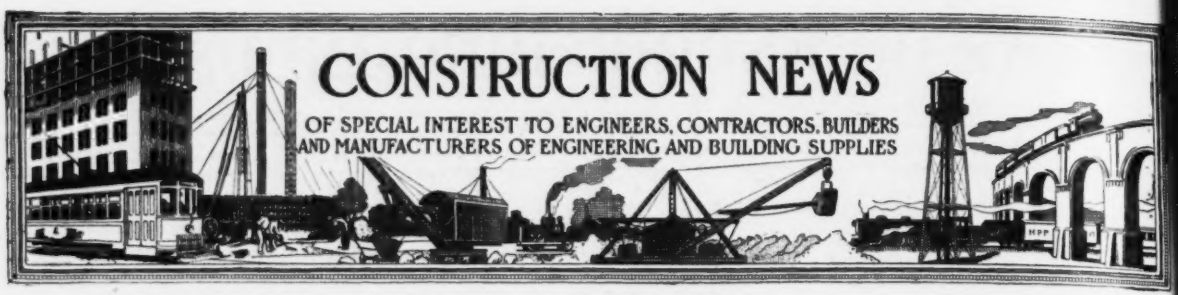
In a paper entitled "Housing and Reconstruction," Thomas Adams, town planning adviser to the Conservation Commission of Canada, pointed out that the provision of houses, as part of a policy of reconstruction, has still to be begun in this country and in Canada. Evidence presented before certain investigating committees of Congress brought out that the increase of war-time output in shipyards and munition plants was due to the increased efficiency and contentment of the workers brought about by better housing.

Good Housing as Necessary Now as in War Times

If it is true that good housing was needed to win the war, Mr. Adams asked, is it not equally true that good housing is needed to win or maintain the victory of peace? The war-housing problem, he stated, has passed into history so far as housing purely war workers is concerned, but there still remains the problem of making up for the shortage of houses caused by the high prices of labor, materials and money. Bad housing conditions are not caused by scarcity of houses so much as by defective Government and false economic ideals, because, even in peace times, with an excess supply of houses, slum conditions persist.

Mr. Adams gave an exposition of England's purposes and plans in spending $600,000,000 on new houses, and pointed out that the density of house building in England will be governed by town-planning schemes, fixing a certain number of houses to the acre and assuring that land purchases, local transit, and house building will proceed side by side, involving extensive work by the engineer.

Apparently having in mind both United States and Canada, Mr. Adams suggested appropriations by the Federal Government to aid state and provincial Governments in improving housing conditions, and further Federal help for highway improvement and for the development of land for housing purposes.


CONSTRUCTION NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

PROPOSALS

For Proposals Advertised See Pages 52 to 54 inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Dec. 17	Boonton, N. J.	Dec. 12
Jan. 2	Galesburg, Ill. Adv. Dec. 5 and 12.	Dec. 12
Jan. 10	Houston, Tex.	Dec. 12

SEWERS

Dec. 19	Long Island City, N. Y.	Dec. 12

BRIDGES

Dec. 19	Marianna, Fla.	Nov. 21
Dec. 20	Petersboro, Ont.	Nov. 28
Jan. 2	New Brunswick, N. J. Adv. Dec. 12.	Dec. 12
Jan. 6	Tulsa, Okla. Adv. Dec. 12.	Dec. 12

STREETS AND ROADS

Dec. 16	Pocahontas, Ark.	Dec. 12
Dec. 16	Dickens, Tex.	Dec. 12
Dec. 16	Louisiana	Dec. 12
Dec. 18	Pascagoula, Miss.	Dec. 16
Dec. 19	Williamson, W. Va.	Nov. 28
Dec. 20	Marion, S. C.	Dec. 5
Dec. 27	Pittsburgh, Pa.	Dec. 5
Dec. 29	Great Bend, Kan.	Dec. 5
Jan. 6	Tulsa, Okla. Adv. Dec. 12.	Dec. 12
Jan. 15	Blytheville, Ark.	Dec. 5

EXCAVATION AND DREDGING

Dec. 16	Kirksville, Mo.	Dec. 12
Dec. 17	Wilkesbarre, Pa. Adv. Dec. 5 and 12.	Dec. 5
Dec. 17	Olivia, Minn.	Dec. 5
Dec. 17	El Centro, Cal.	Dec. 12
Dec. 19	Walnut Ridge, Ark.	Dec. 12
Dec. 23	Caruthersville, Mo. Adv. Dec. 5 and 12.	Dec. 12
Jan. 3	Brownsville, Tenn.	Dec. 12
Jan. 3	Terra Ceia, N. C. Adv. Dec. 12.	Dec. 12
Jan. 7	Albany, N. Y. Adv. Dec. 12.	Dec. 12
Jan. 9	Bridge Junction, Ark.	Dec. 12
Feb. 3	Madisonville, Ky. Adv. Dec. 5 and 12.	Dec. 12

INDUSTRIAL WORKS

Dec. 16	Detroit, Mich.	Dec. 12

BUILDINGS

Feb. 3	St. Paul, Minn.	Oct. 31

FEDERAL GOVERNMENT WORK

Bids Close		See Eng. News-Record
Dec. 16	Electric Traveling Cranes —Spec. 3627—Alexandria, Va.	Nov. 28
Dec. 16	Radial Towers—Spec. 3600 —Monroe, N. C.	Dec. 5
Dec. 16	Freight Station—Spec. 3651 —Indianhead, Md.	Dec. 5
Dec. 16	Sterilizing Equipment — Spec. 3674—Wards Island, N. Y.	Dec. 12
Dec. 16	Fence and Gates — Spec. 3668—Bellevue, D. C.	Dec. 12
Dec. 18	Fuel Storage Tank, etc. — Detroit, Mich. Adv. Dec. 5 and 12.	Dec. 12
Dec. 19	Plumbing—Cleveland, O.	Nov. 28
Dec. 20	Sewer Pipe — Key West, Fla.	Dec. 12
Dec. 23	Pier and Bulkhead — Spec. 3663—Alexandria, Va.	Dec. 5
Dec. 23	Septic Tank—Spec. 3664— Miami, Fla.	Dec. 5
Dec. 23	Tanks—Spec. 3414—Rockaway, N. Y. Adv. Dec. 5 and 12.	Dec. 12
Dec. 23	Extension to Heating System and Power Plant — Spec. 3666 — Paris Island, S. C.	Dec. 12
Dec. 23	Altering Marine Barracks — Spec. 3514 — Ft. Mifflin, Pa.	Dec. 12
Dec. 23	Annex to Dispensary—Spec. 2588—Indianhead, Md.	Dec. 12
Dec. 23	Officers Quarters — Spec. 3677 — South Charleston, W. Va.	Dec. 12
Dec. 23	Kitchen and Mess Hall Equipment — Spec. 3684 — Philadelphia, Pa.	Dec. 12
Dec. 23	Boiler House, Heating and Drainage Systems, etc. — Spec. 3612 — Chatham, Mass.	Dec. 12
Dec. 23	Extending Pneumatic Tube System — Spec. 3658 — Hampton Roads, Va.	Dec. 12
Dec. 23	Wood Pier and Approach— Spec. 3491—Yorktown, Va.	Dec. 12
Dec. 30	Shop and Industrial Buildings—Spec. 3675—Galveston, Tex	Dec. 5
Dec. 30	Radio Building, Garage, Barracks, etc.—Spec. 3683 —Monroe, N. C.	Dec. 12
Dec. 30	Additional Buildings—Spec. 3686—Cape May, N. J.	Dec. 12
Dec. 30	Cranes—Spec. 3681—Washington, D. C.	Dec. 12
Dec. 30	Boilers—Detroit, Mich. Adv. Dec. 12.	Dec. 12
Jan. 2	Lavatory Annexes—Washington, D. C.	Dec. 12
Jan. 3	Post Office—Park City, Utah	Dec. 5
Jan. 3	Post Office—Newburyport, Mass.	Dec. 5
Jan. 3	Post Office—Mt. Carmel, Ill.	Dec. 5
Jan. 6	Post Office — Bakersfield, Cal.	Dec. 5
Jan. 6	Post Office — Lancaster, S. C.	Dec. 5
Jan. 6	Post Office—Caribou, Me.	Dec. 5
Jan. 7	Post Office — Woodbury, N. J.	Dec. 5
Jan. 7	Post Office—Fremont, O.	Dec. 5
Jan. 7	Post Office and Court House —Alexandria, La.	Dec. 5
Jan. 8	Post Office—Prescott, Ark.	Dec. 5
Jan. 8	Post Office—Cody, Wyo.	Dec. 5
Jan. 8	Post Office — Waterloo, N. Y.	Dec. 5
Jan. 9	Post Office—Orange, Tex.	Dec. 5
Jan. 9	Post Office — State College, Pa.	Dec. 5
Jan. 9	Post Office and Court House —Durango, Colo.	Dec. 5
Jan. 10	Post Office — Front Royal, Va.	Dec. 5
Jan. 10	Post Office—Vineland, N. J.	Dec. 5
Jan. 13	Post Office—West Point, Ga.	Dec. 5
Jan. 13	Post Office and Custom House—Ft. Fairfield, Me.	Dec. 5
Jan. 13	Post Office and Court House —Globe, Ariz.	Dec. 5
Jan. 14	Post Office — Southbridge, Mass.	Dec. 5
Jan. 14	Post Office—Cherokee, Ia.	Dec. 5
Jan. 14	Post Office—McKees Rocks, Pa.	Dec. 5
Jan. 15	Post Office — Long Island City, N. Y.	Dec. 5
Jan. 15	Post Office—Kenton, O.	Dec. 5
Jan. 15	Post Office — Bellefourche, S. D.	Dec. 5
Jan. 15	Post Office — Winchester, Mass.	Dec. 5
Jan. 16	Post Office—Eldorado, Kan.	Dec. 5
Jan. 16	Post Office—Shawnee, Okla.	Dec. 5
Jan. 17	Post Office—Franklin, Pa.	Dec. 5
Jan. 17	Post Office—Cohoes, N. Y.	Dec. 5
Jan. 17	Post Office—Buffalo, Wyo.	Dec. 5
Jan. 20	Post Office — Harrisonville, Mo.	Dec. 5
Jan. 20	Post Office—Owego, N. Y.	Dec. 5
Jan. 20	Post Office—Sunbury, Pa.	Dec. 5
Jan. 20	Post Office—Decatur, Ala.	Dec. 5

MISCELLANEOUS

Dec. 16	Lumber—West Springfield, Mass.	Dec. 5
Dec. 18	Auto Eductor, Steam Roller, etc.—Brooklyn, N. Y.	Dec. 12
Dec. 18	Steam Roller—New York, N. Y.	Dec. 12
Dec. 18	Coal Trestle—Binghamton, N. Y. Adv. Dec. 5 and 12.	Dec. 12
Dec. 20	Semi Trailers — Brooklyn, N. Y.	Dec. 12
Dec. 20	Extending Bulkhead — Brooklyn, N. Y.	Dec. 12
Dec. 23	Elevated Railway—Philadelphia, Pa.	Dec. 5
Dec. 23	Shaft—New York, N. Y.	Dec. 12
Dec. 27	Electrical Equipment—Jersey City, N. J.	Dec. 12

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Water-Works

PROPOSED WORK

N. J., Trenton—City plans to lay 10 in. iron water mains in various streets. About $20,000. H. C. Gregory, City Hall, engr.

Wis., Milwaukee—Bd. Pub. Wks. soon lets contract building water pipe tunnel under Menomonee River, from West Water St. to Reed St. and 2 shafts; also laying connecting water pipe line. P. Braman, deputy comr.

Kan., Logan—City election soon to vote $15,000 bonds to improve water-works and electric light plant.

Tex., Houston—E. E. Sands, city engr., soon receives bids improving water works system. Plans include 7 deep wells, deep well pumps, motors and electric generators. About $160,000. Noted Dec. 5.

De